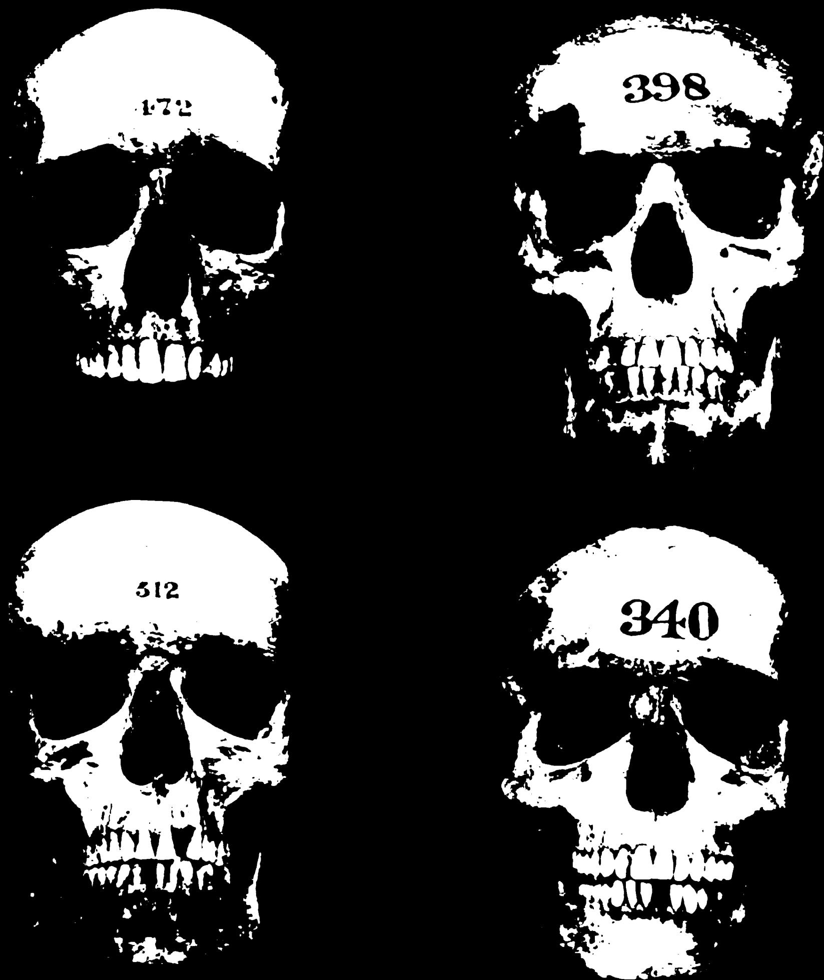

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THE JOURNAL

OF THE

ALLIED DENTAL SOCIETIES

VOL. IX MARCH, 1914 No. 1

A NEW CLASSIFICATION OF HUMAN TOOTH FORMS; WITH SPECIAL REFERENCE TO A NEW SYSTEM OF ARTIFICIAL TEETH[1]

By J. Leon Williams, D.D.S., L.D.S.

"It is only what happens that matters."

Three years ago I presented before this Society the outline of a scheme for a system of artificial teeth, and a plea for a new order of things in dental prosthesis. I had but little material evidence to lay before you in support of the contentions advanced, for that was impossible. But I had something in the nature of a vision, in which I saw an important branch of our professional service redeemed from the low and almost contemptible position it has long remained in. Something of that vision I must have been able to get before you, for the substance of it met with your unqualified approval and you passed a strongly worded resolution giving official expression to that approval and asking the manufacturers to take up the work I had outlined and proceed with it along the lines I had formulated.

Such an undertaking, at that time, must have seemed hazardous to the manufacturer. It called for a very heavy initial outlay. There was nothing in the work that could be patented and no way in which the pioneer in the new field could be protected from the unfair competition which imitation, without initial outlay, would make possible.

[1] Read before The First District Dental Society, New York, December 8, 1913. Because of the limits of space only the most distinctive of Dr. Williams' many lantern slides have been used to illustrate this article.—Editor.

But in spite of these unfavorable conditions we were fortunate enough to find a manufacturing company with sufficient faith, courage and enterprise to take up and carry out the work in a liberal spirit; and to-day I come before you again to announce the early completion of our long labors.

The whole scheme which I laid before you is not completed in its entirety, but there is, we believe, quite sufficient evidence to offer of so great an advance in this field as to make the old order forever intolerable, and thus to place upon *you* the obligation to so encourage the manufacturer that he will carry all phases of the work through to its final consummation.

And now, at the very outset of my lecture, I should like to make it perfectly clear that this system of standardizing tooth forms is not offered to the dental profession as a mere improvement on what has preceded it. It is not an old building with a redecorated interior and a new facade. It is a new structure throughout. Its foundations, I believe, are well and truly laid on a solid basis of scientific fact, with a superstructure designed in accordance with a principle of unity, without which, good art is impossible. And when our work has been carefully examined, when its full scope and the measure of its achievement shall have been clearly seen and understood, I think the universal query will be the one often propounded on the completion of some important undertaking having for its main object a practical benefit to humanity, "Why was this not done before?" The logic and reason of a completed work is so frequently self-evident that we cannot avoid asking that question. But in doing so we overlook the tremendous power of the psychology of habit, the great difficulty in getting outside ourselves for a point of view, and the comforting feeling of ease in following lines of least resistance. It brings no sense of effort or fatigue to take a thing for granted. It is in the overcoming of these psychical conditions that the would-be reformer often finds his greatest task. And that is saying more than a little in this instance, for the material conditions have sometimes presented a formidable front. But the knowledge that every difficulty re-

moved and every obstacle surmounted has contributed something toward placing the finished work on a higher level than it would otherwise have reached is a very gratifying reflection.

In an ancient book in which there are many wise sayings it is written: "To everything there is a season, and a time to every purpose under the heavens;—a time to kill and a time to heal; a time to break down and a time to build up." To-night I shall address myself solely to the former of those two functions. I have to undertake, in the short space of an hour or so, to break down the old system of prosthetic dentistry.[2]

From the standpoint of the reasonableness and force of the proofs at hand, the task seems to me not a difficult one, but I should be a very poor student of human nature if I had not discovered that it is far easier to convince a man's reason than it is to break up the established routine of his bad habits in craftsmanship as in many other things.

However, I am greatly encouraged in my belief that the bad old customs of practice in dental prosthesis are about to receive a rude shock by my knowledge of the fact that in no country in the world are inferior methods, systems and machines so quickly discarded or "scrapped" the moment their inferiority to something new is demonstrated and established, as here in America. American business men found out long ago that it is the truest economy and the surest way to success to throw away an inferior method of production, or a method which produces an inferior article, the instant better methods are discovered. That policy has made Americans the greatest leaders in the business world. It has sent all the nations of the earth here to learn and copy American methods, and to-day you may find those methods being put into effect in the remotest corners of the world. So strong and vital is this influence of American progress that Guglielmo Ferrero, the distinguished Italian historian, says "it is the one idea that has taken deep hold of the European masses during the last fifty years." It has certainly created a new outlook and a new spirit in the world. It has made men more self-reliant

[2] Only the first half of this paper, the part devoted to destructive criticism, was read on the date above mentioned. The latter part of the article was read on March 10.

and given them a greater confidence in their own inherent capacity to subdue the stubborn and apparently antagonistic forces of Nature to human will. It is in that American spirit which says, in the language of the people, "The best we can have is none too good," that I have come here to-day to ask you to discard, to throw away, to utterly destroy and obliterate a system of prosthetic dentistry that has existed far too long, and to establish in its place something more in keeping with the reputation for progress and scientific achievement and character that our country enjoys in other fields throughout the world.

Dr. Ebersole, in a stirring and eloquent call, published in the *Dental Summary* last January, warned you that dentistry was not keeping in the van of American progress. If that is true in any degree of dental practice as a whole, then it is most emphatically true of dental prosthesis. And on that point I believe there are no two opinions.

To remedy the present deplorable condition of things in this field the first important step is to find out the cause or causes of this condition. In my judgment, the chief cause is to be found in the false basis of the present methods and theories for the selection of porcelain teeth and it is, as I have indicated, principally with this theme that I shall deal this evening.

I believe that the chief reason why prosthetic dentistry has fallen so low in the estimation of the profession is that most dentists have an instinctive feeling that with such teeth as have heretofore been supplied, no amount of effort on their part would produce satisfactory scientific and artistic results. I wish, therefore, to try and make it clear why the present system is weak and poor. I want to point out its imperfections and fallacies, its dogmatic assumptions that have no foundations, its ignorance of scientific facts and artistic principles, so that there may be no qualms of conscience, no shadow of regret in saying good-bye to it. This will take a little more of your time than you are accustomed to give to listening to a paper or lecture. But I would ask you to remember that the occasion is a little unusual. You are not

often asked to listen to reasons why you should make a complete and radical change in an important branch of practice.

Two great defects have characterized the manufacture of artificial teeth from the date of their invention down to the present time, a conventionalized or generalized tooth form, devoid of definite character, and the absence of any system of classification, or any fundamental principle or central idea on which the work is based. This statement applies with equal force to the shapes of the incisors and the masticating surfaces of the bicuspids and molars.

There are very definite reasons why artificial teeth should have continued to remain for such a long period in the history of dentistry of a defective and unnatural character and without systematic arrangement. It was hardly possible to have any satisfactory classification of natural teeth, neither was it possible to have fine, natural, artistic forms of artificial teeth without a knowledge of the primary forms of natural teeth. That statement may sound somewhat curious to you, but I hope to make it quite clear, presently, that the primary forms of human teeth have, hitherto, *not* been known. Like old friends, whom we sometimes meet and pass on the streets when our minds are preoccupied, they have been *seen* and not *recognized*.[3]

But to produce a perfect system of artificial teeth there is required not only an intimate knowledge of all the facts of Nature, but also familiarity with the principles of design through which a harmony of related parts, that is often absent in Nature, may be secured. This very essential qualification for the production of artificial teeth seems to have been entirely overlooked.

As a matter of fact, no serious attempt has ever before been made to investigate any portion of this field with scientific thoroughness and accuracy. All the honors in dentistry have been reserved for other departments, with the result that

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[3] Many examples could be adduced to show that long observation does not always result in accurate perception. Herbert Spencer, at different periods in his life, held three distinct opinions about the color of shadows, each one, as he says, "based on years of observation." And his final recognition of what he regarded as the exact truth was due to a suggestion he got while reading a popular work on optics.

many men who have national reputations in what is called operative dentistry, make a mighty poor showing when they turn their hands to dental prosthesis.

Whether or not the reason for this is the one I have suggested, it is, nevertheless, certain that this branch of practice presents a far finer opportunity for the exercise of artistic skill, scientific knowledge and sound judgment than is to be found in any other phase of dentistry. If any one has any doubts on that point I hope he will reserve his final opinion until he has heard the full "argument for the plaintiff."

You will, I think, be able to see more clearly the relation and significance of the facts presented if I state specifically the main objects I have in view in this paper. I shall attempt to destroy all belief in temperamental forms of teeth, for I regard this as one of the most fundamental errors in the present system. I shall try to show that while there are slight variations in the teeth of different peoples, there is no such thing as racial types of teeth. I hope to convince you that the oft repeated statement that Nature always produces teeth in harmony with face and feature is a mistake due to lack of careful observation. And I expect to prove that it is impossible to produce a scientific and satisfactory system of artificial teeth by simply copying sets of natural teeth.

Let us begin, then, with the subject of temperamental classification of teeth. And let me note at the outset that some of our best writers on dental prosthesis say quite frankly that they make use of this theory for lack of a better.

In his excellent book, recently published, my good friend, Dr. Wilson, of Cleveland, has introduced a brief résumé of the theory, but I think I discover evidences that he is not altogether satisfied with it. Other writers, after admitting that there are great variations within the limits of the normal, aferwards say that with few exceptions the forms and contours of the teeth are harmonious with those of the body, but they give us neither principles nor facts on which such a statement is founded.

One author says further that "it is difficult, in some cases, to decide positively to which variety (of temperament) a spe-

cial case belongs. . . . Not infrequently the indications are even contradictory . . . and no rule can be given that will not fail in numerous instances." I submit that a theory of this character is much more likely to mislead than guide the student and beginner, and that it would have been better to drop it altogether in dentistry, as was done in other branches of science long ago. But this course has not been taken, and the theory still has some ardent and dogmatic advocates. I am sure you will agree, therefore, that it is better to subject the claims of this teaching to a thorough critical examination before putting forward the new classification.

Let us first glance at the great, authoritative modern works of reference, to see what they have to say on the subject of temperament.

Our first effort is a little disappointing.

We open the Encyclopaedia Britannica at the place where the word should be, but we do not find it. It is completely ignored. We consult the New American Encyclopaedia of Science and do not fare much better. The word is there, it is true, but used in a sense that connotes nothing of the physical or mental characteristics of human beings. It simply has reference to certain technical matters about *musical instruments*. Gould's Dictionary of Medicine says that the word is spoken of as a vague term or a term vaguely applied. This authority further says that although the original doctrine has long since lost its significance, it is permissible to use it in describing *predisposition to types of mental action:* and that is the manner in which it is sometimes used by good modern writers.[4] Jonathan Hutchinson, F.R.S., with whose work on the teeth you are all familiar, made a careful examination of the claims of the temperamentalists and here is his verdict: "As yet I fear we must say that the labors of the physiognomist and those of the students of temperament have been alike disappointing. Whoever will set himself the task of attempt-

[4] Dr. E. B. Taylor. F.R.S., author of an important work on Anthropology, says: "Anthropology finds race-differences most clearly in stature and proportions of limbs, conformation of the skull and the brain within, characteristics of features, skin, eyes and hair, peculiarities of constitution, and *mental and moral temperament.*" The italics are mine. Dr. Keane, one of the very greatest authorities in Anthropology, applies the word "temperament" solely to psychical qualities.

ing to classify a given number of individuals according to their temperaments will, I think, soon find himself baffled."

The simple truth of the matter is that this whole theory of temperament has been completely discredited and entirely abandoned by all scientific men of standing—except a few of those who rule over the destinies of dentistry. And for them I fear that a mere reference to authorities, however eminent, will hardly be sufficient. We shall have to go a little deeper into the matter, to completely satisfy *them*. But before getting down to the real work of proof, let us have a sidelong glance at those pretentious tables of temperamental classifications with their air of exhaustive research and minute discrimination, which figure so prominently in our textbooks on prosthetic dentistry.

You are all familiar with the results of the researches of Dr. Black and Mr. Charles Tomes into the question of comparative hardness or softness of teeth. You know that working quite independently they both reached the conclusion that the variation in the hardness and softness of teeth was a negligible quantity. The differences are so small as to be a matter of no importance. But if we turn to those tables in our textbooks on prosthetic dentistry which profess to give the temperamental characteristics of teeth, we find the so-called lymphatic teeth, and combinations of the lymphatic, bilious and nervous teeth, described as "soft and brittle"; "soft and frail"; "soft and weak"; "soft and sensitive" "mixture of flinty and chalky"; "soft, weak and chalky," etc., etc.

I shall show you presently that all so-called temperamental characteristics must have arisen in racial characteristics. With that fact in view, the question, "Do those races from which the so-called lymphatic, bilious and nervous temperaments have arisen have teeth that are markedly more soft and frail than the sanguine races?" need only be asked to see the utter absurdity of the whole business stand revealed, even without the classical work of Black and Tomes to prove it.

Then take the indications as to shape and size. We are told that the teeth of a bilio-nervous person are "medium

large" and "long and often narrow" in shape, while the nervo-bilious teeth may be "large or small" and "broad or long." Is that the sort of instruction a dental student requires to enable him to produce harmonious relations between tooth form and facial contour? If you were given a blank form of face of a definite size and of the oval type, let us say, and required to describe the character of the features necessary to produce an harmonious whole, would you say that the mouth might be short or long, the nose large or small, the eyes near or widely separated? In all the wearisome contradictory and irrelevant details of these tables there is never a hint of a fundamental principle on which a student could take his stand for the exercise of his taste and judgment.

Many of you will remember that in the paper which I read here three years ago I pointed out that there was really no foundation for the theory of temperamental forms of teeth. I exhibited photographs of individuals of precisely the same temperaments, according to the rules of the theory, but showing teeth widely different in shape. Since then text books on prosthetic dentistry have appeared in which this theory is given a prominent place. But even more significant, perhaps, is the prominence given to this theory in the recently issued catalogues of two of the oldest and most prominent manufacturers of artificial teeth. I say "more significant" because the prominent manufacturers have the best of reasons for making it their business to know the general trend of belief and opinion in the profession.

In the latest catalogue of one of the largest and oldest firms in England we find illustrations of the three sets of teeth in the lower row of Illustration No. 1, and at the bottom of the pages on which they are shown we read—"The dentures illustrated above are *distinctly typical* of the temperaments described by Spurzheim," and then, as though to specially emphasize the statement that these particular teeth *are "distinctly typical,"* they add that "it must be remembered that a pure type is seldom met with, the majority of the cases being combinations of the features of more than one temperament." The temperaments represented in the three dentures

I have selected are supposed to be the "sanguine," the "bilious" and the "nervous." I will ask you to look very closely at the central incisors, always the most characteristic teeth in any given set, and see if you can detect the very least typical difference. The teeth are not only of one type, but they are very nearly indistinguishable as to form and size. Except as to color, there is not a ghost of a reason why these sets should not all change places.

A representative American firm has also published illustrations of teeth designed for the pure temperaments, as shown in the upper row of illustration No. 1.

Please compare the corresponding types of the two manufacturers. No comment from me is necessary, and I will make none, except to say that these teeth are not made by firms whose reputation is ever called in question. They are firms which are rightly and justly jealous of the high reputation they have honorably earned. But can you look at the specimens of these two companies, each claiming its own work as typical, and each so widely different from the other as to make comparison positively grotesque, without thinking that it is about time we heard the last of temperamental classification of teeth; that it is about time we began looking for something a little more scientific as a basis for tooth form, and also, if I may say so, about time that some one designated and officially indorsed by the profession, to express their views and wishes, took a hand in the designing of artificial teeth?

There are several phases of this theory of temperament, but they all overlap more or less. This may sometimes cause an unavoidable appearance of redundance in the proofs brought against these different phases. And I fear that this fault of redundance, or perhaps it might more correctly be called repetition, will appear more or less throughout the paper. There is so much that is entirely new and foreign to all former teaching in my paper, that it has seemed to me often necessary to present the same facts from more than one point of view.

One writer on the subject of temperament says: "In these temperamental differences, no single sign is more sig-

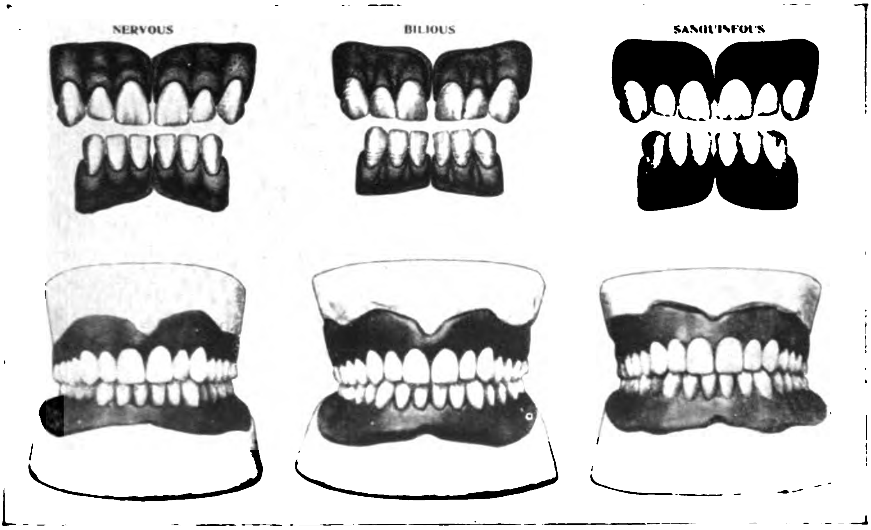

Fig. 1. "Temperamental" types in artificial teeth

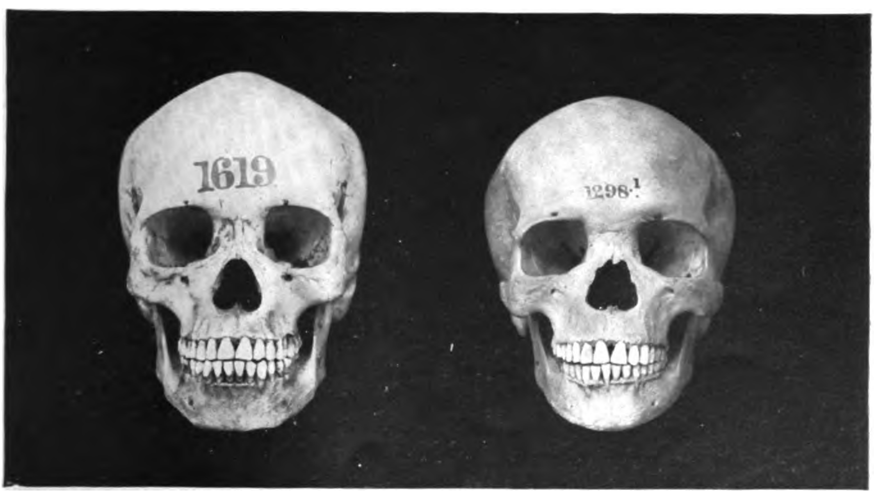

Fig. 2. Similar teeth in dissimilar skulls

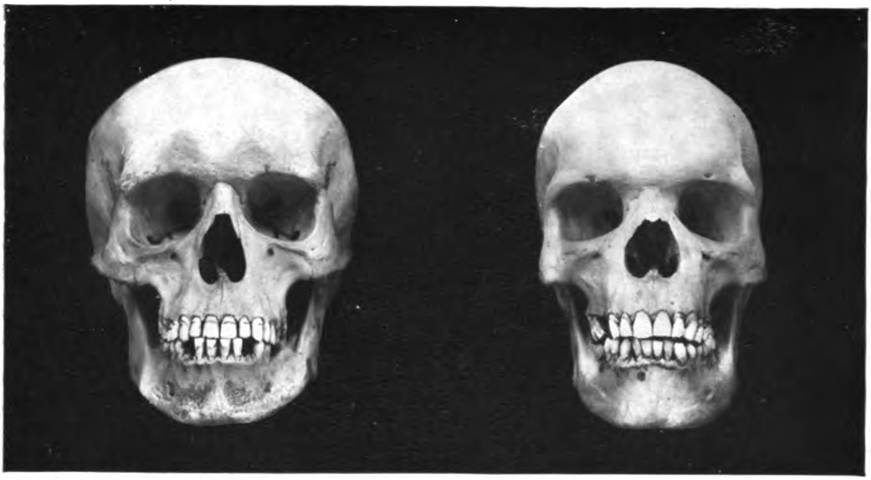

Fig. 3. The wider teeth are in the narrow skull

Fig. 4. Natives of Andaman Islands. Note smaller skull has the longer teeth, and of different type, than the other

nificant than is to be found in the physical characteristics of the teeth—their size, shape, color, density and alignment being as much an index as is the distinctive complexion, the color of the eyes, hair, etc." A little farther down the page it is said: "The law of harmony thus found in Nature between the teeth and other physical characteristics requires—" etc., etc. And once more: "The careful observation and recording of these co-relations would go far toward making prosthetic dentistry an exact science." Here we have three variations of an assumption that Nature always produces teeth that in form and size are in perfect harmony with the face and the individual features of the face. We often meet this assumption in our text books and in magazine articles. On what is it founded?

I have never heard anyone assert that all the other features of every human face were in perfect harmony. The most of us have seen many faces on which we would pass the observation of old Omar Khayyam—if the "sorry scheme of things" were entrusted to us "would we not shatter it to bits and then remould it nearer to our heart's desire?" The great teacher of science, Haeckel, is almost brutal in his remarks on this point. He says in his "Evolution of Man": "If we compare the face of the long-nosed ape with that of abnormally ape-like human beings, the former will be admitted to represent a higher stage of development. There are still people among us who look especially to the face for the 'image of God in man.' The long-nosed ape would have more claim to this than some human individuals one meets." Is there anything more evident to us as we walk up and down the streets or stand in any place where our fellow mortals congregate, than the incongruities of Nature? Even the most fortunate would probably not be willing to give an absolutely unqualified receipt in full to Nature on taking a critical survey of himself in his mirror. Why, then, should we assume that Nature always produces teeth in perfect harmony with face and features? Why should they be an exception to the almost universal rule to the contrary in other particulars? The only explanation I can suggest for this strange incon-

sistency is that an acceptance of the temperamental theory made it necessary. It is, in fact, a phase of that theory. And when we have once given our unreserved consent to a theory it is astounding how completely oblivious we become to the most obvious facts. Let me put a few of the facts bearing on this question before you. Here is a photograph of two skulls (Fig. 2). You will observe that the difference in general contour is very marked. But the teeth, you see, are identical in size and type. If either set is in perfect harmony with size and contour of face, the other set cannot possibly be so.

Here are two more (Fig. 3), a very wide and a very narrow skull. Think what a striking difference there must have been in the facial contour of the two individuals those skulls represent. But you see the widest and shortest teeth are in the long, narrow skull. And here (Fig. 4) are two more from the Andaman Islands—both skulls from the same race. Here again the smaller skull has the larger teeth. Note also that they are of a different type.

Here we have four skulls (Fig. 5) so nearly alike in size and contour that a single set of teeth would be just as suitable for one as another of them, but look at the difference in the natural teeth. At least three of those must be examples of disharmony. And now are shown four more (Fig. 6). These skulls are of a very different type from the four preceding ones, but they are, as you see, of one type. A glance at the teeth is sufficient to demonstrate the mistakes of Nature. I could take up the whole evening in showing you examples of this sort, but as further proof on this point will appear incidentally when I am considering other phases of my subject, I will not dwell longer on it now. Unless someone can advance good and satisfactory reasons for believing that Nature is more solicitous about the harmonious relations of our dental organs with other features than she is about those of our eyes, ears or noses, we will conclude that the subject is always open to the intelligent criticism of an artist in teeth.

The advocates of the temperamental theory always assume that when a man and a woman of opposite temperaments mate, the offspring will be a blend of the two tempera-

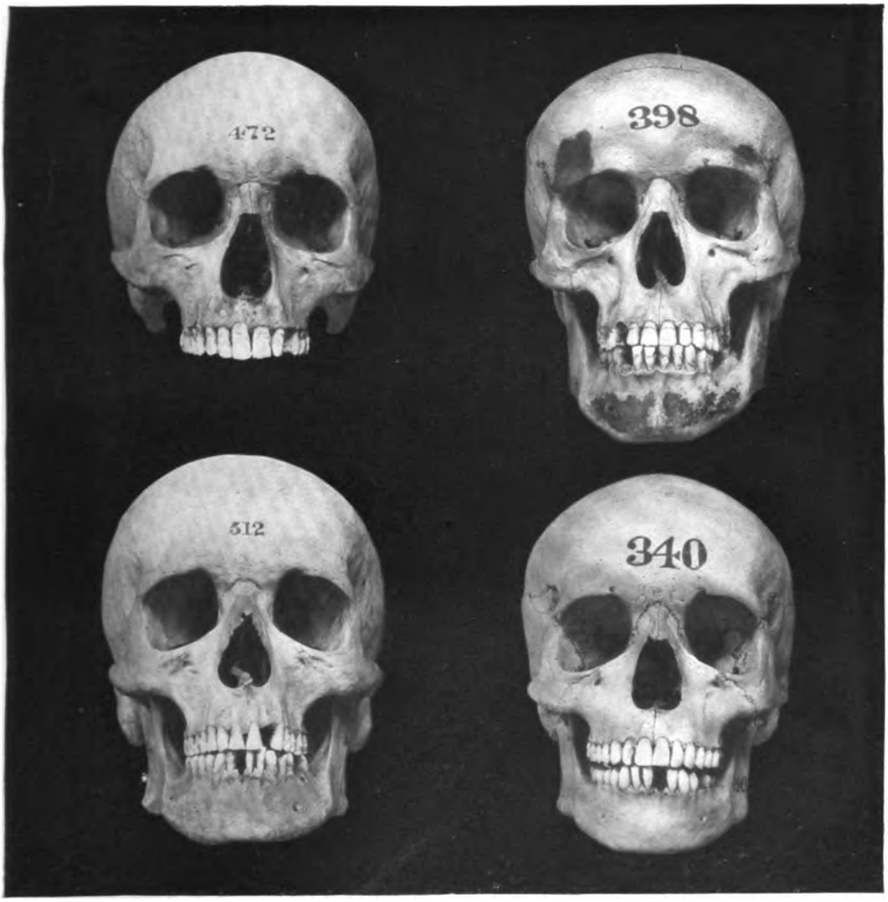

Fig. 5. Four skulls of same type, but with very dissimilar teeth

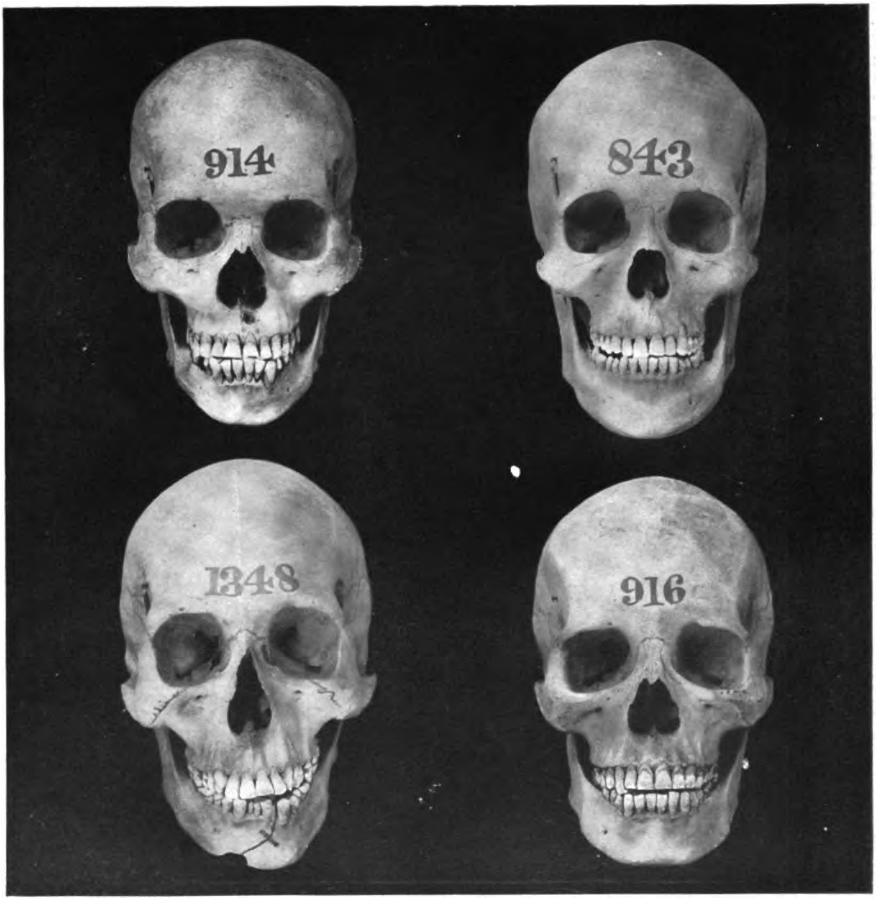

Fig. 6. Dissimilar teeth in similar skulls

ments. To a certain limited extent this may sometimes be the case, but more frequently we see a juxtaposition, so to say, of the salient features of both parents. This might have been known either from observation or from a knowledge of the more recent researches in heredity.

The works of Mendel, Weissman, Galton, Thomson, Bateson and others have made it clear that certain characters are dominant in one parent and other characters in the other. One child may inherit the general facial peculiarities of the father, and the complexion, color of eyes and hair, and the teeth of the mother. In another child these conditions may be reversed. In Sicily, that old battle ground of the races, where the blood of the blue-eyed, fair-haired followers of Norman Roger has mingled with that of the Arabs, I have often seen just such effects of this crossing of types as I have mentioned, and one may see in Ireland people with black hair, dark skin and blue eyes.[5]

What is the value of the temperamental theory of tooth form in instances like these?

And now, consider for a moment the basis on which the whole theory rests. It is founded on the idea of four groups or classes of individuals called the pure temperamental types and known as the sanguine, the nervous, the bilious and the lymphatic, in accordance with the alleged dominance of the physiological functioning of the blood, the nerves, the bile, or the lymph. What do the advocates of this theory mean by the dominance of these systems? Obviously but one thing can be meant, and that is that the action of the heart or the liver or the lymphatic system or the nervous system is stronger or

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[5] Broca and Thurnam, in the Memoirs of the Anthropological Society, describe a group of sixteen ancient skulls, nearly all perfect, found in France at Nogent-les-Vierges. Three of them are described as the dolichocephalic skulls of Aryan stock, eight as the brachycephalic of Mongolian origin and five as a cross of the two. These latter had the high, narrow forehead of the long headed race, while the middle and occipital regions of the skulls had the width and fulness of the round headed race.

Thomson, in his fine work, "Heredity," says: "A white man of considerable intellectual ability marries a negro woman of great physical beauty and strength: the result may be—has been a mulatto, who inherits some of his father's intellectual virtue and some of his mother's physical strength." Again, "If a tall variety of (sweet) pea be crossed with a dwarf, *all* the offspring are *tall*, and among *their* offspring in turn three-fourths are tall and one-fourth dwarf, *but none between the two*." The italics are mine.

Thomson further says, when speaking of Mendel's law: "Experimental work has driven home the conception of unit characters . . . that are inherited independently.

dominant in the individuals characterized by these terms. People of the sanguine temperament should show a stronger action of the heart, those of the bilious temperament greater activity of the liver and people of the nervous temperament should be distinguished by greater intellectual achievements and brain power generally.

Well, I have a large collection of photographs of some of the most eminent persons of this country and Europe and I find that all forms of faces and physical characteristics are included among the ablest and most intellectual people of the world.

But it may be pertinent to ask who has ever made any experiments of a severely scientific character to prove that the action of the heart is stronger in so-called sanguine persons, or the liver more active in bilious persons, or the brain larger in the alleged nervous temperament? Who has ever conducted such experiments to prove anything about temperament as indicative of physical characteristics?

Who has ever determined the temperament of a negro or an Arab? Are the individuals of all races except Europeans, alike in their physical and psychical characters? If not, what physical peculiarities in a Chinaman, a native of Australia or a Hindoo correspond to those alleged to be indicative of the nervo-sanguine temperament in an American?

Who has ever got together, even a dozen people of one temperament, selecting them by their alleged physical temperamental peculiarities *without* looking at their teeth, and then examined the teeth to see if they were all alike or of one type?

If that simple experiment had ever been made it would have been seen that this pretentious structure (the temperamental theory) is as frail as a house of cards and as empty as a soap bubble. A recent writer in the Edinburgh *Review* says: "The greatest discovery ever made in philosophy was that the way to discover whether a thing is present is to *look and see*. It was proclaimed by Aristotle in the ancient world and by Francis Bacon in the modern world." The extent to

which that simple rule is neglected is one of the astounding things of life.

And now let me lay before you the final and crushing proofs of the utter futility and fallacy of this theory.

What is the origin of those physical characteristics that are called temperamental? You have on the screen pictures from life in which are represented the three great races from which it is believed all the modern peoples of the earth have arisen. The black race is represented by the South African Medicine Man; the yellow Mongolian race by the group of Chinese; and the Caucasian peoples by the blue-eyed Norwegian bride. The three distinct types of skulls, long, broad and medium, most characteristic of distinct races, are also represented in these three types.

Away back in neolithic, or even in paleolithic times, there were two races in Europe—the long-headed or dolichocephalic type, and the broad or round heads, the brachycephalic type.[6]

The Caucasian race is, possibly, a later evolutionary development.

The portraits I have just shown may be taken as the modern representatives of those ancient races. Broadly speaking, the fair races, and, to a large extent, the yellow races, are found in Northern and Central Europe and Asia, while the darker races occupy the Equatorial and southern regions. From the mingling of those light and dark races, the working of the principle of variation, and the modifying effects of climate and general environment, there has arisen all the racial or temperamental characters that the widely varied inhabitants of the earth exhibit.

There are many theories and there is much speculation about these ancient races, but all theories and all known facts are in agreement on the point of the meeting and mixing of dolichocephalic and brachycephalic races in Europe in prehistoric times.

It is a very fascinating theme, but we cannot dwell upon

[6] Professor Duckworth, of Cambridge, England, writing of the Krapina skull, says: "It is shown that early paleolithic man presents examples of skulls both of brachy-cephalic and dolicho-cephalic proportions."

it now, and the main facts are all that is necessary to our purpose in tracing the origin of temperament. What we really know beyond controversy is that everything denoted by the term temperament must have arisen in or originated from race. We can see clearly enough that most of the peculiarities described as sanguine must have been transmitted by the Caucasian race, while the bilious features were inherited from the dark races, and the Mongols have most of the distinctive traits called "lymphatic."

If we now open a book such as Stewart's on "Our Temperaments," the latest and best work on the subject that I have seen, and find portraits of such individuals as those now shown on the screen, we know that the physical or so-called temperamental characters which they present did not arise spontaneously and without cause. The immediate ancestors of that man with red hair and blue eyes were not natives of Africa. The parents of that swarthy individual with dark complexion and black eyes and hair were not full blooded Swedes or Norwegians; and we can predict with reasonable certainty that there is a Mongolian strain in that so-called lymphatic person with the pipe who looks so comfortable and altogether satisfied with himself. In other words, we can discover no special trait or characteristic in these individuals who are supposed to be representative of the different temperaments, that is not even more clearly shown in the representatives of the great races which were exhibited a moment ago. In fact, the only difference is that these temperamental types are further removed, by crossing, from their racial origin. The real significance of the term "pure temperamental" is that the individual instance shows, in a mixed race, an unusual reversion to the dominant racial type. The mixed temperaments are simply the result of the mingling of the blood of different races, somewhat modified, in the event of migration, by changed environment.

If, therefore, there is such a thing as a sanguine type of tooth or a bilious type of tooth, they must have originated in the sanguine and bilious races. If there are special, characteristic, temperamental forms of teeth, there must have been

racial forms from which they were derived. There is no possibility of evading the logic of that conclusion. And I think it has always been assumed by our profession that there *are* racial forms of teeth. I think you will find many references in our literature to this supposed fact.

Now, a *racial* form of tooth must mean a *distinctive* form peculiar to a *race*. But if I am able to show you that there is no such thing as a racial form of tooth, if I can prove beyond all possibility of doubt that there are certain primary forms of teeth which are, in their general type characteristics, common to all races, light and dark, ancient and modern, savage and civilized, then I submit that even the unreasonable minority will have to agree that all belief in a temperamental type of tooth must go.

There are certain differences as to size and small differences in proportion of width to length in teeth of the same general type in different races, but *as to essential differences in type, there are none.*

When I began my work of investigating the forms of human teeth at the Royal College of Surgeons, in London, it was with the belief that there were racial types of teeth. I had no doubt about it. I had so often seen statements to that effect that I simply assumed that it was true.[7] And when I did not succeed in finding any form of tooth characteristic of race I concluded that my failure was due to race admixture. Even with the most sincere desire and the strongest determination to find out the truth, still what we have been taught, our inherited beliefs, will continue to haunt us for a long time, like unhappy ghosts who see their continued existence endangered and fight for it with all their might. I pursued this study for nearly a year, and during that time I was accumulating a great store of individual human teeth. The largest lot that reached me from any one source came from the University of Pittsburgh by the kindness of Professor Friesell. But for this interest and generous action on his part I doubt

[7] I had particularly expected to find strongly marked differences between the teeth of the dolichocephalic skulls of the peoples descended from the Aryan stock and those of the brachycephalic skulls representing the ancient Mongolian races. I also expected to find that the teeth of remote insular groups, such as the Andamans, Fijians and Tasmanians, would present strongly marked typal features.

if the discovery I am about to lay before you would have been made. One day it occurred to me that it would be a good idea to begin sorting and arranging the central incisors into groups. (I had long seen that these were the most characteristic of human teeth.) As I proceeded in the work it became evident, after a time, that I was accumulating *three* very strongly marked groups with a larger number partaking more or less of the combined features of those three groups, but generally with the features of one or other of the three groups dominant in every individual tooth. When I had finished arranging my incisors in this way I again went to the Museum of the Royal College of Surgeons to see what light this discovery would throw on further study there. I was more than a little surprised to find these three types of teeth in almost every group of skulls which contained a dozen, or even less, with the incisor teeth intact. My long search for something fundamental had been rewarded. I had at last got what I was after—the key to tooth form. All along I had seen that there were different types of teeth in all the different races, but the co-relation of these different forms had never struck me until I went there with the knowledge of what to look for. That is generally the way with all discovery. We walk unsuspectingly over gold mines and oil wells if we do not know how to look for them. When I saw clearly that these three types of teeth existed in all races, I knew instantly that I had got Nature's secret of design in human teeth, and I knew that it would now be possible to beat her in her own work; for Nature, working more or less blindly, makes endless mistakes, as I have previously indicated, while we, working intelligently, can avoid those mistakes. I saw that the existence of three types of teeth was the fundamental fact in human tooth form and that every conceivable form of human tooth could be evolved from those three types, and I knew that it would be possible to design beautiful and anatomically correct forms of teeth if I never saw a human tooth again.

Let us now examine in detail the proofs of the statements that Nature produced three typal forms of teeth in all races

and modeled all teeth upon these three. You have on the screen a photograph (Fig. 7) representing a small but representative selection of the three primary forms or types of human teeth. In all reference to them they will be designated as Class I, II, and III. Class I is characterized by the parallel or nearly parallel lines which represent the proximal surfaces of these teeth for half or more than half of their length from their incisal edges. In Class II these lines converge so markedly that they would meet in most instances, at a point near the end of the root. These converging lines are sometimes nearly straight, but usually there is a very slight convexity of the mesio-proximal surface and a slight concavity of the distal surface. Class III, which I regard as the most beautiful form of human teeth, and which has rarely if ever before been used as a model for artificial teeth, is characterized by a delicate double-curved line on its disto-proximal surface and sometimes, though less frequently, on the mesial surface. All of the surfaces and angles of teeth of this class are more rounded and graceful than in either of the other two classes. The specimens shown in this photograph represent the most severe or typal shapes of what I call the primitive forms of human teeth. My reason for the use of the word "primitive" will appear later. All of the other teeth in any given set partake of the features of the central incisors but to a much less marked degree. But in this respect the natural teeth of a given set are not always in harmony. The crossing of races or some other cause often disturbs the perfect harmony of line of the different teeth in a set, and you may sometimes find centrals of one class and laterals and canines of another. But usually the harmony is more or less perfectly preserved. In designing artificial teeth we can, of course, *always* maintain a proper harmony throughout and thus improve on Nature. The succeeding photographs will show you laterals (Fig. 8) and canines arranged in the order of the three classes. As I have intimated, the class characteristics are not so marked in these teeth as in the centrals, but you will have no difficulty in seeing in any of the groups something of the special features of each type. In this photograph you see the effects of crossing

the types. There is more or less blending of the primitive forms, although in nearly every instance the dominance of one type or another can be perceived. Probably the majority of teeth in all mixed races are of this character.

We will now pass to an examination of the teeth of some of the more important civilized and savage races of ancient and modern times, in which I shall show you that the three types or classes of teeth I have illustrated and described are to be seen in the skulls of all these otherwise widely divergent peoples. In this first exhibit, the skulls will all be shown in groups of three, thus presenting in one view the three primitive forms of teeth in each race. We will begin with three skulls from a savage race of to-day—the Sandwich Islanders (Fig. 9). The shape of the skulls differ markedly, but this difference in skull shape has no necessary relation to the different forms of teeth. We have here the three primary forms of human teeth very clearly shown. We have the square tooth with parallel sides in skull No. 1, the pyramidal shaped tooth with its converging lines in No. 2, and an ideal specimen of Class III, with its beautiful curves in skull No. 3.

As you would expect, not all of the teeth in the different groups of skulls which I shall exhibit are such perfect examples of the severer forms of the three classes. Probably perfect examples could always be found if one had a sufficiently large number of skulls at command. The surprising thing is that even in a small collection of skulls, often less than a dozen, I have always been able to find fairly good representatives of the three classes, but I believe that the more severe typal forms are more frequently found in those races in which there has been the least crossing.

The next view is of three Javanese skulls.[8] Here the centrals in Class III have been slightly modified toward the oval form: Class II is well represented by the pyramidal shaped teeth in skull No. 2, and No. 1 shows a very good example of Class I.

Here we have three skulls from another ancient civilized

[8] I do not think that these skulls represent the true aboriginal natives of Java. They are probably those of a mixed race.

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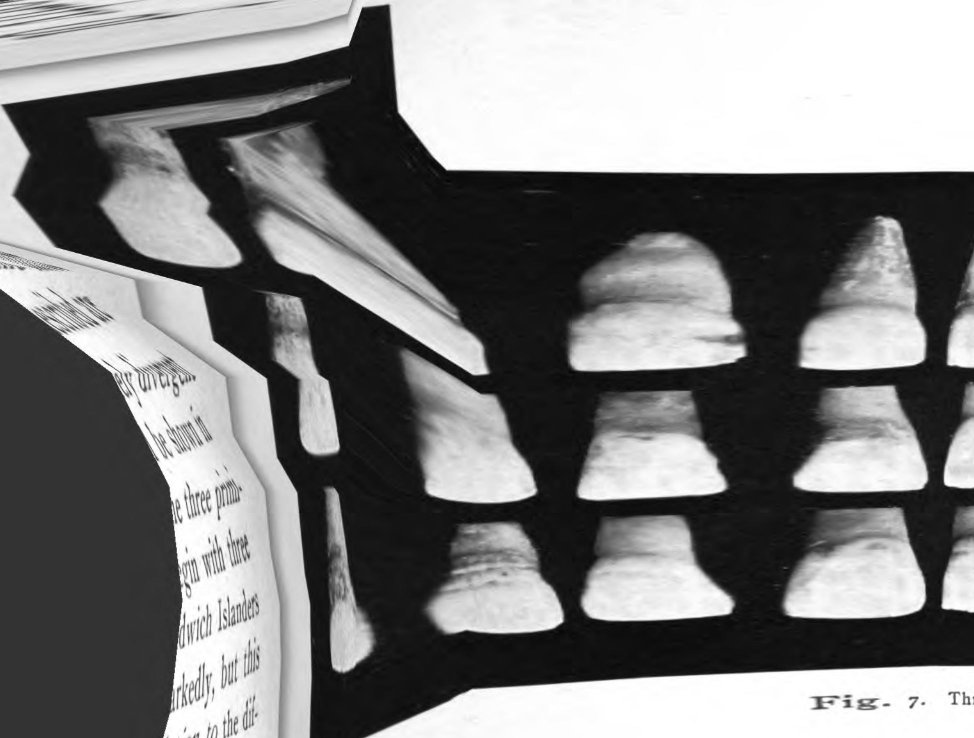

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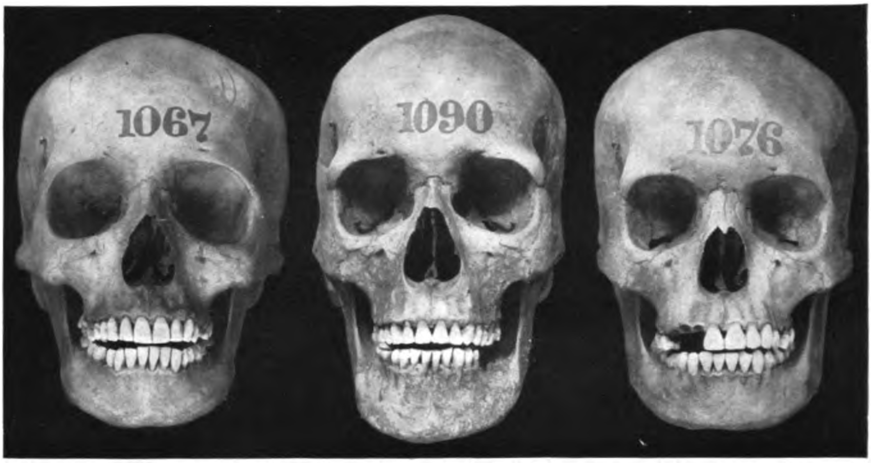

Fig. 9. Sandwich Islanders, showing three classes of teeth

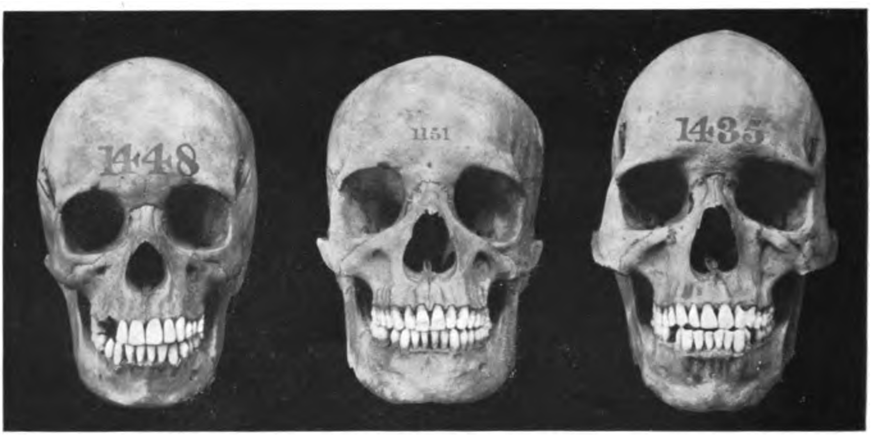

Fig. 10. Fiji Islanders—varying tooth forms in same race

race—the Chinese. No. 1 shows a slightly modified form of the typal tooth, but Nos. 2 and 3 are excellent representatives of their respective classes.

The next group shows two skulls of the modern German. I was unable, in the small collection of skulls at my command, to find a good example of No. 3 in this series. It should be said that the photographs, in many instances, do not show the characteristics of the different forms of teeth as clearly as they would be seen in handling the skulls.

Three modern Greek skulls are shown in this view—1 and 2—very good examples of their class, No. 3 somewhat modified in the direction of 2.

Skulls of modern Hindoos—all excellent specimens of their respective types.

Three strongly marked forms of Patagonian teeth—No. 1 very slightly modified toward the oval shape; No. 2 typical and No. 3 an interesting modification in which the line of double curve appears on both mesial and distal surface.

A group from the New Hebrides. Nos. 2 and 3 are perfect examples of their classes, while No. 1 is slightly modified in the direction of Class III. Notice the wide divergence in shape of these skulls.

These are three Spanish skulls. I had a rather poor collection to select from in this group. But they are interesting in their way. They all represent modifications of the three primitive forms of teeth and might be called secondary types with the primary form dominant in each specimen. No. 3 is especially interesting as it represents a form of tooth of decided character frequently met with. The converging lines of the type are somewhat rounded or curved, the mesial line always more sloping than the distal. There is nearly always slight overlapping with this form of central.

French skulls. Classes II and III well represented. Class I shows a coarse modification of the typal form.

These three from the West coast of Africa—all fine characteristic examples, although No. 3 is somewhat marred by the filing of the centrals.

Three specimens from Italy. Nos. 1 and 3 typical. No. 2 modified.

A group from the Fiji Islands (Fig. 10). Please observe that when the teeth are not all good examples of the primary forms of their class, yet the variation in form is so great as to completely upset the theory of a racial type of tooth.

Two Kaffir skulls. Perfect examples of classes. The next two and three groups of skulls is, in some ways, the most interesting in the entire collection shown you to-night. The natives of Australia (Fig. 11), Tasmania (Fig. 12) and New South Wales represent the lowest type of human beings of modern times. The skulls of these savages have many points of resemblance to the Anthropoid Apes. Here, if anywhere, you might expect to find a racial form of tooth. But just observe the difference in the shape of these skulls and teeth. With the exception of the teeth of the ancient Egyptians, these low Australian savages exhibit the characteristics of the three primitive forms or types of teeth more clearly than any others in the groups I have shown. No. 3 is, I believe, regarded as one of the greatest anatomical treasures of the Museum of the Royal College of Surgeons. It probably shows more intimate relationship with the Anthropoid Apes than any other modern skull. It was received from Australia just as I was finishing this work of investigation and was photographed for the first time for me.

The last group in this series that I shall show you (Fig. 13) is from that very interesting ancient race, the Egyptians of the III and IV dynasties—a period dating more than 2000 years before Moses led the Children of Israel out of Egypt. We are back in the Bronze Age at the dawn of what we call civilization, the time of the Troy of the Iliad and before the Great Pyramid was built. It was a piece of great good fortune to have found three such perfect skulls from this far distant era, showing so perfectly the three primary types of teeth. They are each ideal specimens of their class. The teeth in skull No. 1 answer perfectly to the description given in our text books of the sanguine type of tooth, but I believe all authorities are agreed that those ancient Egyptians did not have

Fig. 11. Natives of Australia

Fig. 12. Natives of Tasmania

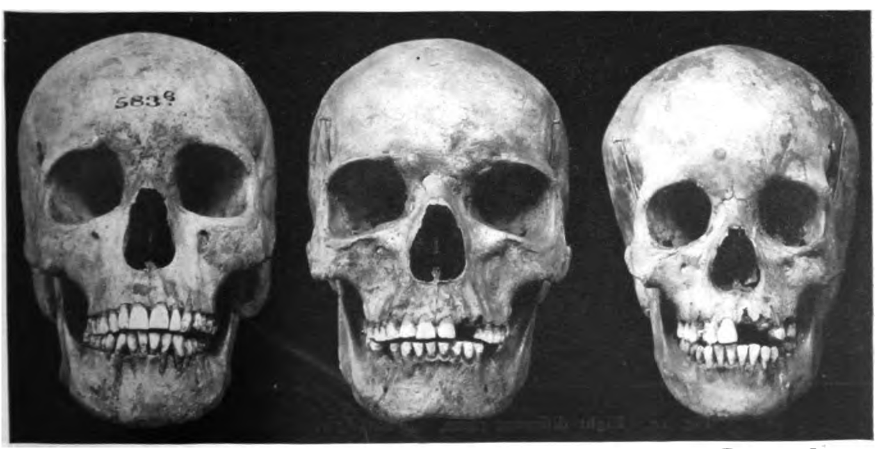

Fig. 13. Ancient Egyptians, showing three primary types of tooth forms

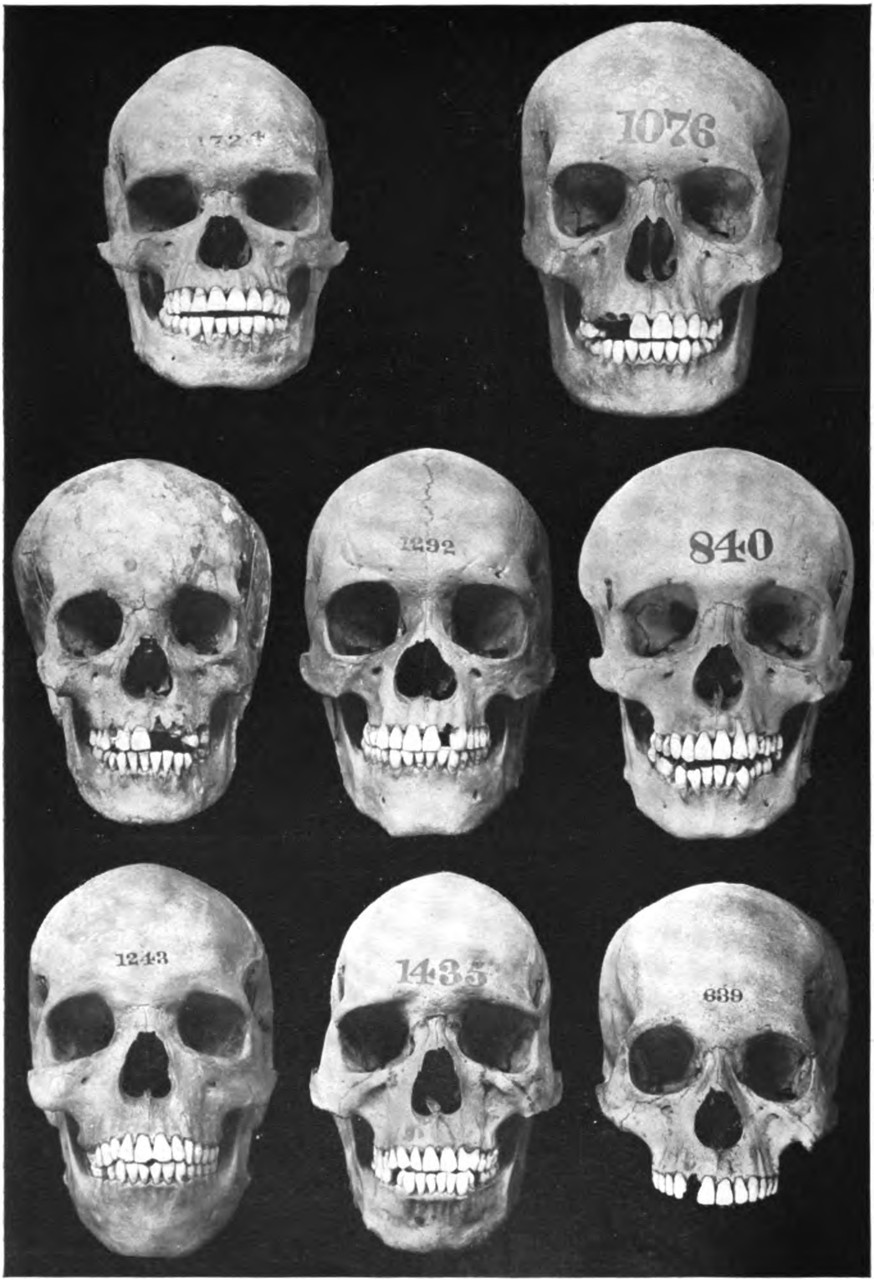

Fig. 14. Eight different races, all having teeth of class III

light hair or blue eyes or a ruddy, light skin. There is evidently a mistake somewhere—perhaps it is the fault of the Egyptians. But the forms of teeth shown in the other two skulls have never been observed by any advocate of the temperamental theory of classification. New temperaments will have to be invented for them.

Suppose the teeth in all three of these skulls had been, as might easily have happened, of type I, a strong tooth full of character. Would it not have been said that here was the typical racial tooth form of the ancient Egyptians? This mistake concerning racial types of teeth has grown out of insufficient critical observation.

I think a little diversion from our main theme, just to relieve the mental tension for a moment, may be acceptable. The most of you probably know that these ancient Egyptian kings had what you might call supplementary names—a sacred name, and also, at least sometimes, a name taken or given them for some accomplishment and characteristic quality. Now the name of one of the kings of the period represented by these skulls was Sneferu or Snefru. According to one eminent authority the English interpretation of his sacred name was "he who makes good." That expression, you see, is not quite so modern as you may have thought it. And Snefru also had another name bestowed upon him for his prowess in dealing with his enemies. He was known as "the wielder of the big stick"—that expression, too, was not invented yesterday. To prove to you that I am not romancing in this matter I show you a picture of Snefru that is sculptured on the rock walls of the Wady-Maghara near Sinai. There he stands, club in hand, over his fallen foe.

To exhibit in another striking way how teeth of the different types or classes run through all the widely divergent races, I have arranged a few photographs in pairs. The full meaning of what I have to show you will be more vividly presented if I exhibit before each group of teeth, portraits of individuals of the race represented by the skulls showing the teeth. You will thus have in mind at the moment a clear picture of the wide divergence of races in which there is a substantial identity of tooth form.

And I may as well mention right here that the practical significance of these facts is that they demonstrate and prove that a system of artificial teeth designed with a knowledge of all the facts about the human teeth is equally suitable for all the races of the earth. It covers the whole field and that has never been done before.

Our first group is a native of the New Hebrides and a modern Spaniard. At first thought it seems almost incredible that any two individuals of races so far apart in racial characters should have teeth that are practically identical. But the two skulls now shown on the screen prove to you that such is the fact. The centrals and laterals in both are of precisely the same type.

We have shown here a Hindoo and a Javanese as widely divergent in outward appearance as the Spaniard and the New Hebridean. But when we look at the skulls of representatives of these two races we find again identity of tooth form. The teeth of the Javanese are slightly worn, but they are otherwise the same in form and size.

In this view we have a native Australian and a woman of Germany. It is not necessary to call attention to the striking contrast of these faces.

But what about the teeth in these two examples? You see a striking difference in the size and form of the skull, but the teeth are identical in type—both being fine specimens of Class II.

A modern Chinese and a Patagonian.

Here also the teeth in both skulls are of Class II, but in this instance those of the Patagonian are slightly larger, the laterals markedly so.

In these two portraits we probably have as strong a contrast in physiognomy as could be found in any two human races that have ever inhabited our earth. In looking at this portrait of one of the last of the Tasmanians, a race that has only recently become extinct, one cannot fail to be struck with the striking resemblance of the nose and mouth to those same features in the chimpanzee.

But when we look at the skulls from these two races we

see that in the teeth all contrast has disappeared. Here, indeed, we have the one physical touch of Nature that makes the whole world not only akin, but of one family. I shall have time to show you but one more illustration of the identity of tooth form in different races, but in this group I will give three examples—a Kaffir, an Egyptian and a native of the Sandwich Islands.

You see a striking difference in size and shape of skull, but identity in type of tooth, and but very little difference in size.

Let me now call your attention to two views which present a still stronger proof of the fallacy of the racial type theory.

You have on the screen a photograph of eight skulls (Fig. 14), representing eight different races as different in physiognomy, shape and size of skull and general race characters as it is possible to find. The central incisors are all of one type —Class III—the form of tooth that has never before been observed. In this next view you have nine more skulls (Fig. 15), all from different races, and in these you have another distinct type of tooth, that of Class I with slight variations, and this form also, you see is common to all the races.

While the view of a considerable number of skulls is before you I will once more ask you to note the fact mentioned several times, during the course of this lecture, that Nature does not always produce a definite type of tooth for any given form of skull.

During life, the individuals which these skulls represent must have presented a great variety of facial contours. But observe how many of the central incisors in these widely varying skulls are alike or nearly so. Look at that upper row of four skulls. The teeth are identical in type and nearly so in size. But what a contrast in the skulls, especially in 1448 and 398, and again you see the smaller skull has slightly larger teeth.

Some of you may be thinking that I specially selected these specimens from a very large collection of skulls. But I did not; I took what I already had in hand for other pur-

poses. They are simply different groupings of those which were first shown on the screen.

Again I say the proof that Nature produces no perfect harmonies of relationship in the different parts of organisms is to be seen on every hand. It is before our eyes all the time.

In bringing forward so many of these contradictions of Nature, I may seem to be introducing an unnecessary confusion. But what I am really trying to do is to bring order out of confusion. And in any event I think it is always much better to know and face all of the important facts in any problem, but I hope no one will take the demonstrations and facts I have just presented as warranting the conclusion that natural teeth are always so imperfectly adapted to face and features, that this relationship may be neglected. That would be as far from the truth as the assumption that Nature always produces a perfect harmony between teeth and face. The important point which contains the gist of the whole matter is simply this: there is such a considerable minority of cases in all mixed races, especially in all widely divergent races in which crossing has recently occurred, in which there is more or less disharmony in the relation of features, that it would be a disastrous mistake either to found a system of artificial teeth on the assumption that all natural teeth are in harmony with the organism, or to conclude that in edentulous cases no improvement over the natural teeth which the patient had is ever possible.

More than that, I will say that anyone who will take the trouble to examine and compare forty or fifty skulls from almost any race will be forced to the conclusion that if he wishes to follow Nature blindly in the matter of adapting teeth to facial contour he has a fairly wide range of choice in making his selection. It would probably express an important truth to say that Nature seems to be always striving to reach or realize harmony, but rarely achieving a perfect success, and sometimes going very wide of the mark. The great variety of inconsistencies in Nature emphasizes in a most striking manner the paramount importance of finding some fixed principle of harmony between tooth form and facial con-

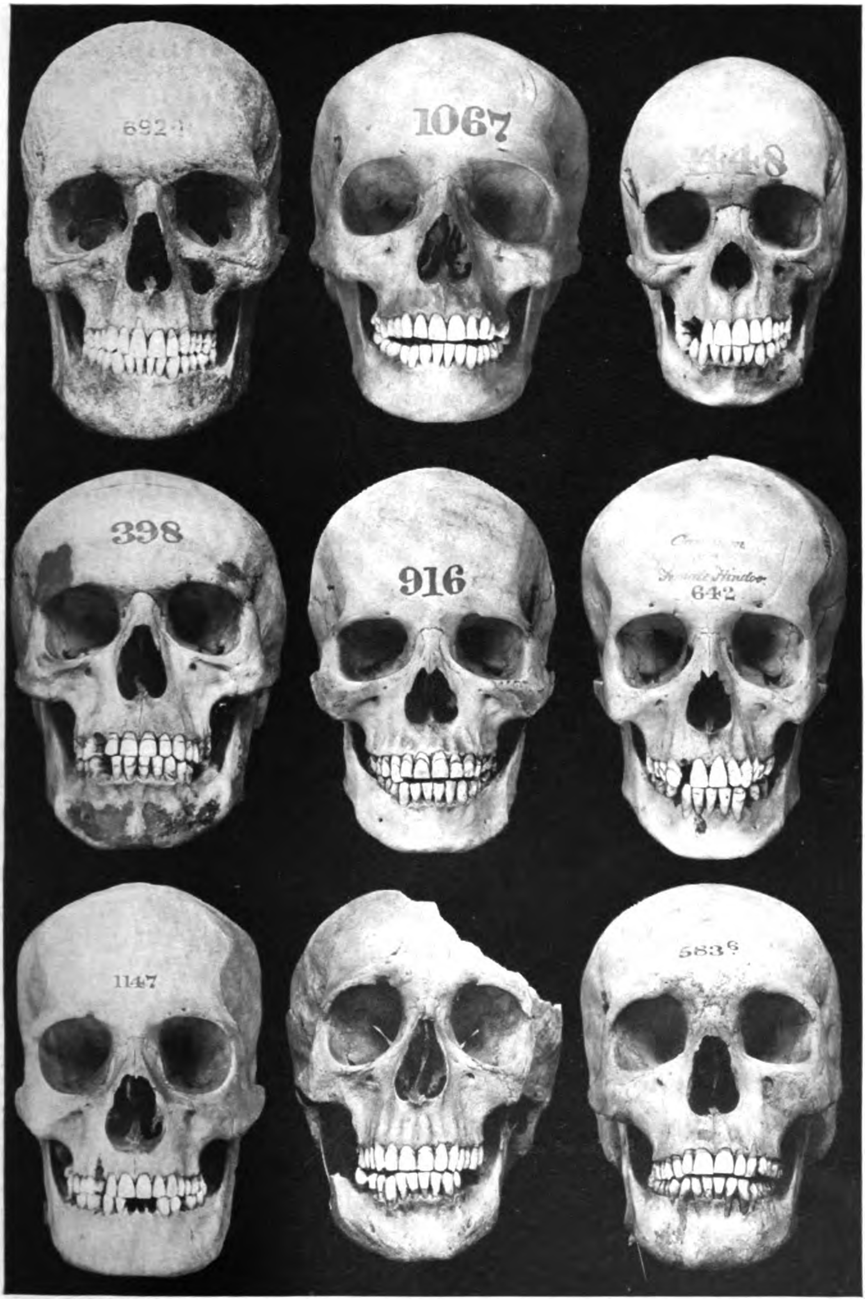

Fig. 15. Nine different races, all having teeth of class I

Fig. 16. Prehistoric skulls. Neander that at the left

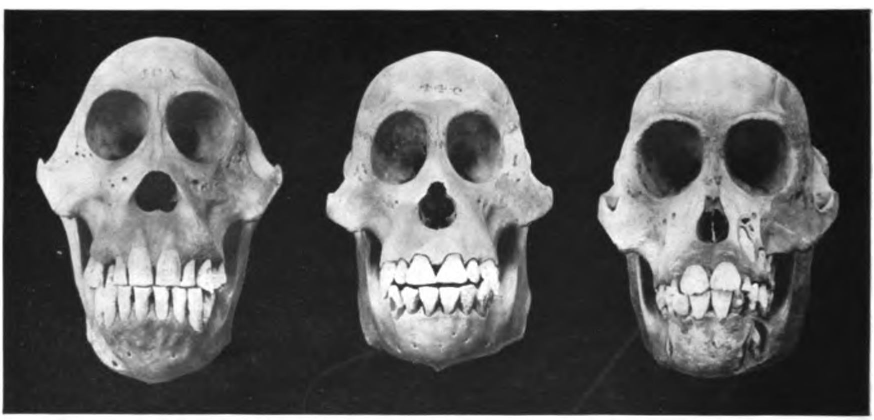

Fig. 17. Skulls of orang-outang, showing three primary tooth forms

tour. Art must supply us with that which Nature has failed to give us. What we have to do is to study closely the majority of instances in which an approximation to harmony is seen, and from the knowledge thus gained to deduce the general principles on which the highest possible degree of success may be based. No clear, definite statement of such principles is to be found anywhere in our literature.

The one important fact we have established up to this point is that there are three types of teeth common to all races.

I have no need to labor this point of identity of tooth form in different races or to press for conclusions in the least, beyond what the facts will fully warrant, but I submit that I have destroyed the last vestige of a belief in a racial type of tooth. And along with the passing of that belief there must disappear also the theory of a temperamental type of tooth. My summary of the whole matter is this: That as a working theory it has always been so vague in statement and indeterminate in application that it has never taken any serious hold upon dentists and is practically a dead letter with more than nine-tenths of the profession; that to teach a theory which no one really practises or understands is immoral, because it leads directly to a disbelief in any scientific basis for prosthetic dentistry; that if there had ever been any real desire to undertake a practical application of the theory it would not have been possible to do so because no manufacturer of artificial teeth has ever made any successful attempt to comply with the demands of the theory; and lastly, that the theory has absolutely no foundation in scientific fact, because it is fully and incontrovertibly demonstrated that any given forms of teeth are not peculiar to any race, neither do they bear any necessary relation to the shapes or sizes of skulls. In all races there is community of typal tooth form. Small variations in size and small variations in proportion of width to length there certainly are in the teeth of different races, but the three types or classes are present and distinct in all the races I have examined. In fact, one of the most interesting things to me

in the course of this investigation has been to see how the three types everywhere persist through the small variations observable in the teeth of different races.[9]

Although just a little aside from our main subject, I think it will interest you to have a glance at a few prehistoric skulls (Fig. 16). The three now shown, reading from your left to your right, are known to anthropologists as the "old man of Cro-Magnon," a representative of the race of the same name, the Coombe Capelle man, representing the Aurignacian race, and the man of La-Chapelle-aux-Saints, a typical skull of the very ancient Neanderthal race. Their estimated ages range from 25,000 to 150,000 years. I believe no prehistoric skull has been discovered with an overbite of the upper incisors. The two shown on the right, you see, have an edge-to-edge bite. The third one, the man of La-Chapelle-aux Saints, must have been a very astonishing and savage looking creature with a very projecting muzzle, huge, flat nose, enormous eye sockets and heavy supra-orbital ridges. Observe that his teeth were nearly all lost from loosening and decay. This skull is also from the Cro-Magnon race. Notice the great depth of the lower jaw and the size of the central incisors, which are fine specimens of Class I. I have another skull of the same race in which the teeth are of a totally different type—approaching Class III—with rather small and very beautifully modeled teeth.

The next slide and the following one show a peculiarity or a specialization of the teeth of the Neanderthal race, which enables us to recognize this ancient people whenever teeth of this type are discovered. This peculiarity is twofold—fusion of the roots and enormous size of pulp cavity.

This photograph shows the efforts of three different artists, all trained anthropologists, to represent different types of prehistoric races.

Let me now call your attention to another discovery I have made, in relation to what has already been shown, that

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[9] Keane, in his table of Ethnology, describes the teeth of the negro races as large (macrodont), those of the Mongols and native Americans as medium (mesodont) and the Caucasian teeth as small (microdont). But the teeth of the mixed races range through all these sizes.

Fig. 18. Three types in skulls of gorilla

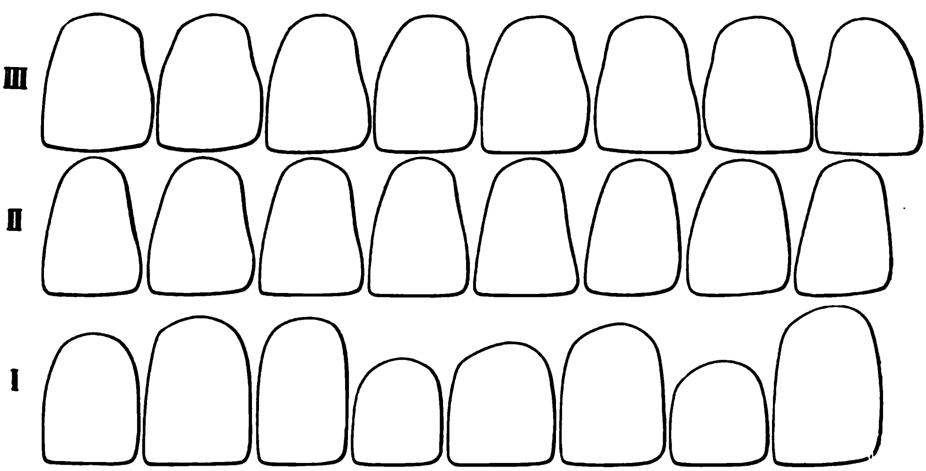

Fig. 19. Variations in three primary types

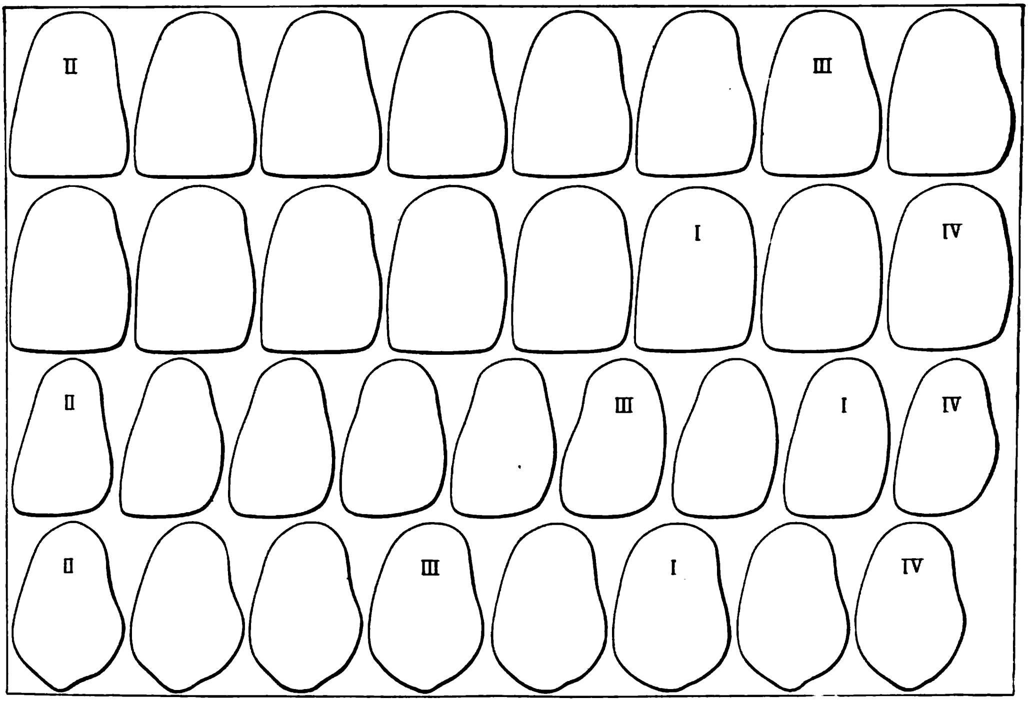

Fig. 20. Blending of classes in centrals, laterals and cuspids

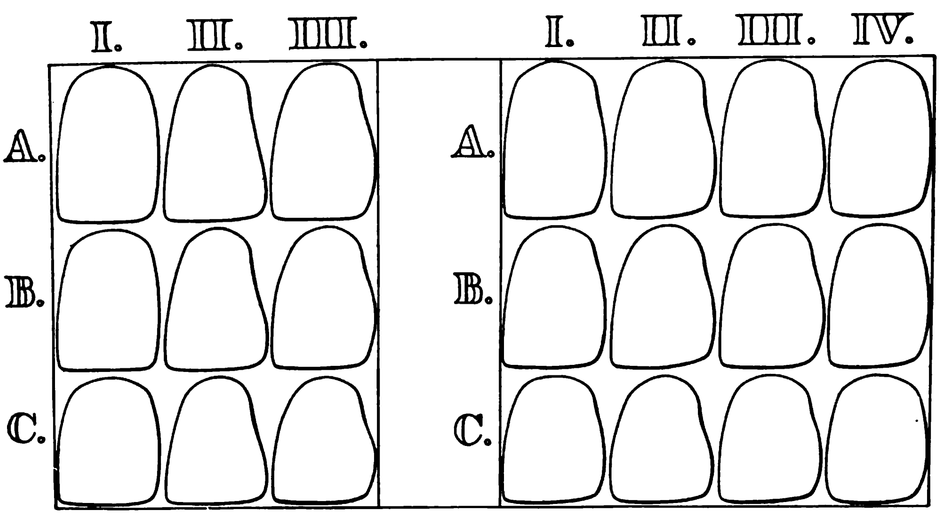

Fig. 21. Variations in lengths in pure and blended types

is not only interesting to us as dentists, but has also proved to be of deep interest to anthropologists and workers in other scientific fields. The significance of this discovery is that it traces the origin of these three types of teeth back to a·time antecedent to the advent of humanity. When I had made thorough examination of the teeth of the lowest and most primitive races, finding everywhere the three distinct forms, it occurred to me one day that the teeth of the anthropoid apes might throw some light on this question of origin of types. You now have on the screen a photograph (Fig. 17) of three skulls of the orang-outang. I have selected these as representing the group of anthropoid apes because the teeth in these three skulls were the most unworn and perfect available at the moment, but the facts are the same with reference to the gorilla (Fig. 18) and the chimpanzee.

You will observe that we have here the three types of teeth that we have seen in all the races shown, but, as you would expect, the characteristics of each are rather more strongly marked than in the genus *Homo*. You have the central incisor with parallel sides, the representative of Class I, the incisor with sharply converging sides of Class II, and the one with the fine double curve on its distal side and the generally rounded form which is the special feature of Class III. If there is any temperamental significance in these forms of teeth in the anthropoid apes, I should be glad to have it pointed out.

Another very significant fact in this connection is that in the anthropoid apes the variation in the proportion of width to length of the central incisors in Class I is very marked, some being very short and others very long, while in the other two classes this variation is very slight. Exactly the same thing is true of human teeth. It is for this reason that Class I, in our system, has a series of three lengths with five sizes to each length, while the forms in the other two classes are produced in series of sizes only, or with but slight variation in proportion of width to length.

Whatever the ancestral form may be from which man and the anthropoid apes have descended, or ascended, it is

plain that we have here one of the most striking homologies that has been discovered. It is an especially interesting evidence of relationship because it is one of Owen's classical examples of homology and analogy.[10]

The teeth are still functional in both man and the apes. It is clear, therefore, that the origin of the three types of human teeth can be traced back into what the old-fashioned orator was fond of referring to as "the dim mists of antiquity." We have reached something fundamental here that is of very great importance in our work. Man has three types of teeth because they have been bequeathed to him from his simian ancestors, just as he has five fingers and five toes, because they have been passed on to him from the early amphibians. You now understand why I call the three severe types or classes of human teeth the "primitive" forms.

It may interest you to know that this discovery of the fundamental types of teeth in man and the anthropoid apes as shown in these photographs, has been submitted to quite a number of the foremost scientific men of the United States and Europe, among whom I may mention Prof. Henry Fairfield Osborn, President of the American Museum of Natural History, Professor Schafer of Edinburgh, President of the British Association of Science for 1912; Professor Keith, Hunterian Lecturer at the Royal College of Surgeons, and author of "Types of Ancient Man"; Dr. Woodward, of the Natural History Museum, South Kensington; Dr. A. Russell Wallace, co-discoverer with Darwin of the principle of Natural Selection, and Prof. Ernst Haeckel, of the University of Jena, admittedly the greatest authority who has ever lived in matters of comparative morphology in man and the lower animals. It was of Professor Haeckel's great work on morphology that Huxley said: "It is one of the greatest productions in the history of science." And Darwin said that if he

[10] "The wing of a bird and the wing of a bat; they are both fore-limbs of similar structure and development; they are both organs of true flight; they are at once homologous and analogous."—Owen.

"When two or more structures, organs or specialized parts, in one and the same organism, or in several organisms, show a deep resemblance in their architecture and also in their manner of development, they are said to be homologous. . . . Now, the evolutionary suggestiveness of homologies is indisputable."—Evolution, by Thomson and Geddes.

had read Haeckel's "Comparative Morphology" before he began the "Descent of Man," that book would never have been written.

Very interesting comments have been made and no word of criticism has been passed on what seems to be the inevitable conclusion of the facts shown in my photographs. But as the discovery was in the field of comparative morphology it was Professor Haeckel's opinion that I particularly desired.

I think the letter conveying that opinion to me is sufficiently characteristic and interesting to warrant publication.

He says:

JENA, 6, 1, 1913.

DR. LEON WILLIAMS,
LONDON.

DEAR SIR.—Your observations on the three different types of the upper central incisors are very interesting, and mainly the fact that the same three characteristic types occur also in the orang-outang and in other anthropoid apes. In my opinion this fact is another new and convincing proof for the near relationship between man and the anthropoid apes, and for the phylogenetic theories that both have been derived from one and the same common ancestor. First, the fact that these three types—in physiological relationship of little value—are so distinctly developed in three morphological directions, seems to me an important proof that the way of phylogenetic divergence of characters is the same in man and in the anthropoid apes.

Very respectfully yours,
(Signed) ERNST HAECKEL.

With what admirable clearness and conciseness Professor Haeckel's masterful mind has gone straight to the mark in that letter. Three forms or types of teeth have no special physiological significance, as he says. One type is as good as another for purposes of mastication. But the morphological meaning conveys the story of man's origin, and so becomes one of the most fundamental facts about human teeth.

And on that fundamental fact is established the new classification.[11]

I have several times intimated during the course of this paper that the makers of artificial teeth have never had any scientific guiding principle either for classification or design. Let me finish with that subject now, and I will then take up the constructive part of my work. What have the manufacturers done when they have wished to produce a new pattern of their so-called natural form teeth? They have looked about until they found what they considered a particularly attractive looking set of teeth, either in a skull or in the mouth of some living person, and have then copied this set of teeth as well as they could. Well, that work is a long step in advance of the old products of the tooth factories. But for whom are those teeth suitable in artificial dentures? On the assumption that in Nature a set of teeth is in perfect harmony with the face and features, that particular set of teeth could not possibly be in perfect harmony with a different face. But I have called your attention to the fact that should always have been obvious to us, viz., that in Nature there is rarely more than approximations to harmony and often such a lack of harmony that the grotesque is suggested.[12]

If the set of teeth copied was not in harmony with the skull or the face in which they were found, what suggestion has ever been made for their harmonious use? When the manufacturer wishes to produce another mould he finds another set of teeth, and for a third mould a third set of teeth, and so on, ad infinitum. As the minute variations in natural teeth are probably only limited by the number of people dead and living and to be born, is there any good reason why the manufacturers should not go on to the end of time producing new moulds of teeth? And have they not always acted on that principle? Have not all the companies in existence been

[11] "In connection with the skull, I may speak of the teeth-organs which have a peculiar classificatory value, and whose resemblances and differences of number, form and succession, taken as a whole, are usually regarded as *more trustworthy indicators of affinity* than any others." Man's Place in Nature, Huxley. The italics are mine.

[12] In the so-called Natural-form teeth on the market I have noticed that certain natural defects have been copied which make a perfect anatomical occlusion impossible.

turning out new moulds of teeth steadily for nearly a century? Working according to their present plan, is there any reason why they should ever stop? What is the relation between the teeth of one manufacturer and another? There is none except when they copy each other's patterns, which they frequently do. Nor is there any ordered relation between the teeth of any one manufacturer. The end of all this is a chaos of confusion doubly confounded, a vast heterogeneous mass of artificial teeth in which no real artistic principle has been embodied. The present method, even at its highest and best, that is to say, when natural teeth are copied as closely as possible, is an artistic failure, because a work of art cannot be produced by baldly copying Nature.

Let me repeat here and emphasize what I have said in a former paper on this subject, that while all art work must be founded on the most intimate, penetrating and thorough study of Nature that it may be true to life, yet truth to life means much more than an indiscriminate consideration and acceptance of a mere welter of facts. It means the appreciation and understanding of the relative value of facts, and the power or faculty of discriminating between what is of small value and what is important, characteristic, relevant, fine, all that is really vital to the subject. And that statement fairly introduces the whole problem in the constructive part of our work, which we now approach. The heart of that problem is such a thorough mastery of all the facts of Nature as will enable us to know what it is that gives character in our work and what detracts from it; what makes it beautiful or what causes it to look ugly or commonplace.

Out of the vast confusion and imperfection of Nature we have to isolate, so far as we can, the pure elements of truth and beauty in tooth form, and impress those elements into our service in the work of designing a system of artificial teeth. We have to attempt what every artist undertakes when he seeks to give expression to a more or less ideal conception he has formed after long study and communion with Nature.

When that little group of French artists known as "The Barbizon School" were living together on the borders of the

forest of Fontainebleu, someone asked Millais one day which tree he thought the most beautiful, from the artistic point of view. After a few moments' consideration, he replied: "The one that is in harmony with its surroundings." A fundamental principle in art was never more finely stated. Exactly the same language may be used to express the relationship between tooth form and face. That tooth is most beautiful for any face which is in most perfect harmony with it. Very well, then we have to determine, if we can, just what it is that constitutes this harmony. Is it entirely a matter of taste and individual judgment, or is there a principle involved which may be demonstrated so that all may see and benefit by it?

Here, as always, we must go to Nature, not to copy baldly everything that we find, but to discover the essential thing. Everyone who has had any experience in this field knows that if he were to place a set of oval teeth in the mouth of a person who had a very square face, or a set of long teeth in a very short face, the disharmony or falseness would be glaringly evident. Even the novice in dentistry would almost instinctively select a square tooth for a square face, and a short tooth for a short face. But why are the straight lines of a square tooth in harmony with a square face, and the curved lines of an oval tooth in harmony with an oval face? If we can demonstrate the application of a principle in an obvious case, then we may also be able to apply it when the conditions are somewhat more complex or obscure. I can hardly repeat too frequently that the whole problem is purely an art problem, because that very important fact has never been sufficiently recognized. Now, in all works of art, whether of drawing, painting, sculpture or architecture, harmony or balance is secured in two ways, or by the application of two rules—by parallelism and by opposition of line and curve, and usually by the combination of the two. Excluding color for the moment, *that is the most fundamental thing in all art work.* The severe, classic beauty of a Greek temple is secured almost wholly by the parallel lines ot the columns, which are not quite parallel or quite straight. And those upward shooting lines also constitute the chief element of beauty

in the more ornate Gothic cathedral of later times. The beauty of the Apollo Belvedere or the Venus de Milo is entirely founded on the balance or opposition of curved lines, and a painting by Turner or Claude or any other great master owes its artistic merits, so far as composition is involved, entirely to the balance of both straight and curved lines.

The principle laws of harmony in all art work involving outline may be briefly stated as follows: Lines that are parallel or nearly so are harmonious; lines that converge or diverge must have other lines, shorter or less in number, set in opposition to them to produce harmony. Curved lines running in a similar direction are harmonious, but branching or diverging curved lines also require opposition lines to complete their harmony.

Those laws or rules are just as applicable to the designing and use of artificial teeth as to building a temple or carving a statue. They are the only rules by means of which a high degree of success may be reached in the adaptation of tooth form to facial contour, and their application is perfectly simple and free from ambiguity, as we shall see presently.

During all the time that I was laying before you proofs of the fallacy of the theory of temperamental tooth form, of the theory of racial tooth forms, of the idea that Nature always produces harmonious tooth forms, and the notion that the way to produce a system, or rather, the absence of a system, in the making of artificial teeth is to copy natural sets of teeth—while I was presenting all of those proofs, I was, at the same time, by use of the facts those proofs contain, building up a system of classification founded not on imaginary distinctions but on scientific realities. The facts that disprove the temperamental theory are the facts on which the new classification is based.

We are now in a position to gather up the somewhat scattered threads of our proofs and arguments and to show their real significance in the work of designing a new system of artificial teeth. As a solid basis for that, we have established a new classification for natural teeth in the three primitive forms shown and the secondary and other forms produced by the crossing of these primary forms.

In those three primary forms of teeth we have all the elements of design necessary for producing an indefinite number of varieties of artificial teeth. But an indefinite number are not required. On the contrary, we require comparatively few forms, for the reason that there are but few types of human faces.

In Stewart's book on temperament, to which I have referred, there are eighteen tables arranged, giving the characteristics of mixed temperaments. In seventeen of those we have the square face and therefore a single type of tooth, of varying size and color, would supply the need for all. The descriptions giving that single type of face in seventeen mixed temperaments, by the ablest and most modern exponent of the theory, gives the final stroke of absurdity to the elaborate tables devoted to the subject in our text books.

In the elements of design we have in the three primary types of natural teeth we see what a perfect means we have for producing artificial teeth of all forms necessary for the most complete harmonious relations with every type of human face. When we come to analyze these elements of design, we find that they are very simple, but, as I have said, capable of an indefinite number of beautiful combinations.

You have on the screen a picture of these elements of design, separated or analyzed as a few curved and straight lines, and combined as one of the typical forms of our classification. Let us see how by slight variations of those few lines we can produce every conceivable form of human tooth—and you will see that we produce our variations after the method of Nature—by crossing the typical forms.

I told you in a former paper that all the fundamental principles of art and design could be applied to the making of artificial teeth. Now what does a competent artist do when he has it in mind to design a fine picture? He decides on the subject and general plan of his painting, and then proceeds to make many careful studies of all the elements which are to appear in the finished work. When it comes to the final composition of the picture, he probably makes several trials before he gets that perfect balance of line and mass that satisfies him.

That is precisely the method that has been employed in designing all these forms of teeth. The suggestions for most of the designs have come from natural teeth. The first step has always been to make a number of accurate studies or drawings of the outlines of those natural teeth most closely resembling the intended form. First the centrals, then the laterals and canines, and last, the lower incisors are then all laid out so that all can be seen at once and compared. There will be some lines that balance, that are harmonious, and others that are discordant. The problem is precisely that of designing a good composition—to secure perfect harmony of line and mass, and that is not an easy matter in so small an object as a tooth. When it comes to the carving, several are sometimes discarded before the perfectly satisfactory result is reached, but usually when the first central incisor has been passed as right, the finishing of that particular set is less difficult.

All variations in the models of artificial teeth designed for the different types of face are produced by slightly varying the curvature and balance of line of those few simple elements of design in accordance with the contour of face for which the tooth is designed. But the knowledge of how to do that in the best and most artistic manner possible can only be acquired, as all other artistic knowledge is, by much experiment and by long and concentrated study of human teeth and human faces.

The most important result of making a great number of outline studies of natural teeth, such as I have just shown, is the knowledge it brings of just what changes of outline on the proximal surfaces it is that converts a tooth of one class or type into another, and just how far those changes can be carried to modify a given type without passing into another type. The aim, in designing artificial teeth, should always be to maintain character in the tooth by keeping its typal or class features dominant. The most uninteresting and unattractive tooth is one in which the characteristics of all three of the primary types have become so blended that it has no distinction. It is characterless. This whole subject can be illus-

trated and demonstrated in a few moments by diagrams or outline drawings.

You have here perfectly accurate outline drawings (Fig. 19) of specimens of natural teeth of the three primary classes. You will remember that when I was showing the teeth of the orang-outang I called your attention to the great variation in the proportion of width to length shown in the teeth in Class I. The upper row in the view on the screen illustrates this point again, and I will ask you to keep it in mind when I come to describe the system of constructing porcelain teeth.

The teeth in the other two rows have all been drawn to the same length, but the proportional width has been preserved. By the crossing of these three types, Nature has produced every form of human tooth that has existed, through all the ages down to the present time. Every form of human upper central incisor is one of those forms, or a slight variation of one of them. In the very nature of things, and by virtue of all that is involved and meant by the term evolution, some one of those forms or variations will be better adapted to or more harmonious with a given type of face than another. But we have seen that Nature exercises no very fine discrimination in adapting tooth form to facial contour. That means that the vast majority of her variations in teeth are of no particular artistic value. They can be discarded or ignored so far as a system of teeth for edentulous cases is concerned, and the forms that are produced can be far more perfectly adapted to characteristic facial outline than any except the few rare triumphs of Nature. I can illustrate and demonstrate that fact to your complete satisfaction by one of the photographs,[18] I have already shown, which is there on the screen again. After what I have already pointed out to you, I do not believe there is a dentist in my audience who could not suggest, after a few moments' study of those two skulls, modifications in one set of teeth which would make them more harmonious with the main lines of the skull. You see that the top of the skull on the right is more rounded, and the descending lines of the sides more converging, than those same features are in

[18] No. 2.

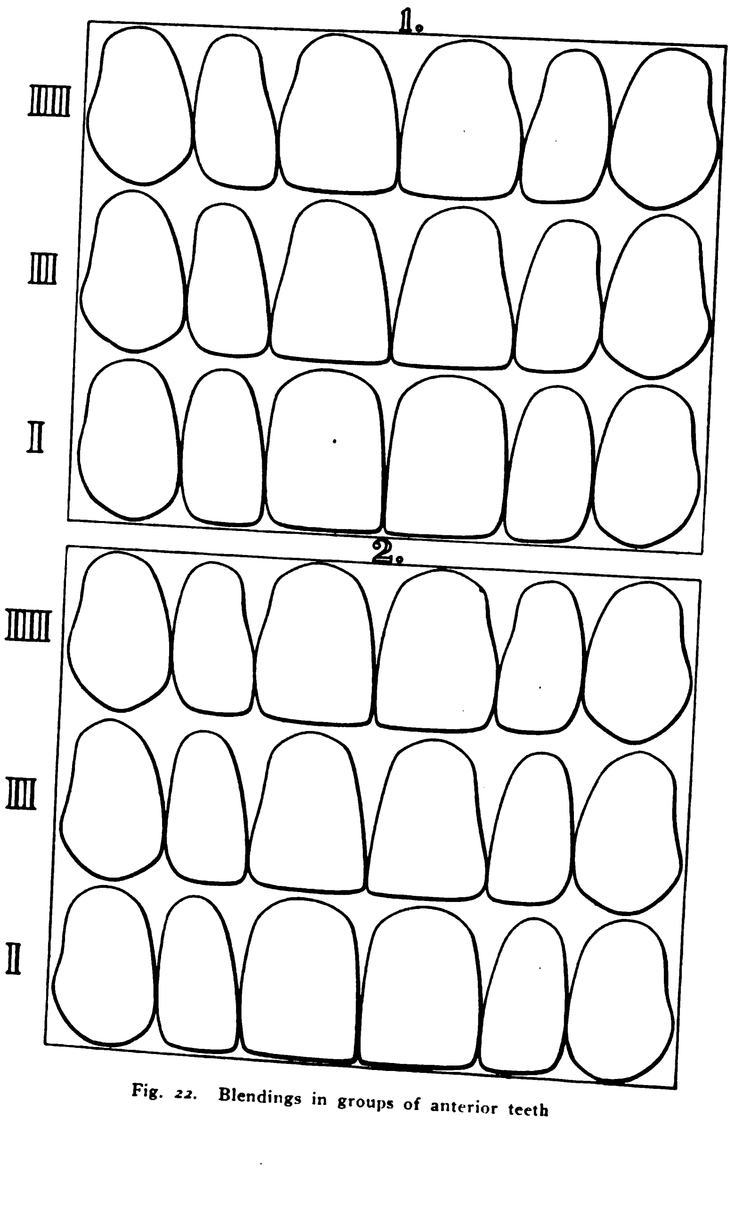

Fig. 22. Blendings in groups of anterior teeth

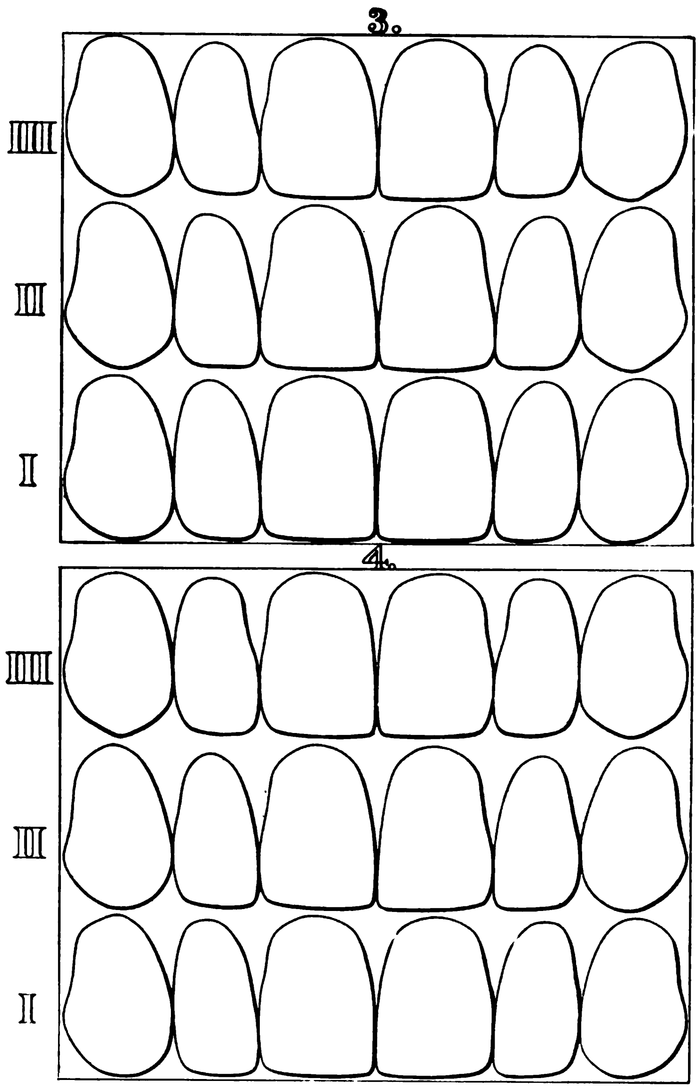

Fig. 23. Blendings in groups of anterior teeth

the one on the left. The harmony between teeth and skull is much finer in the one on the right. The converging lines on the mesial sides of the teeth are exactly right for the tapering form of the face, and the rounded distal surfaces are in perfect keeping with the general roundness of the head. But the lines of the centrals in the other skull should have less convergence. They should be less flowing, straighter and firmer to correspond with the main lines of the skull.

No one would think of questioning these suggestions for improvement when the principles on which they are based are once pointed out. I hope I have made perfectly clear, in this little digression, the point I have so often insisted on, namely, the possibility of sometimes securing in artificial dentures forms of teeth better adapted to the face than Nature had supplied. Let us return to the subject of systematic design.

In the chart now seen on the screen (Fig. 20) I have endeavored to show what a power, resource and control in design in artificial teeth has been made available by the discovery of the primitive types of teeth.

The first two rows represent, as you see, upper left, central incisors. My object here is to show how, by crossing the types we pass, by almost imperceptible gradations, from one type into another. I am following Nature's methods, but excluding her eccentricities and grotesqueries. I begin with the typical form of Class II, crossing it with the typical form of Class III, and then crossing again with Class I. The difference between the typical forms in Class II and III is that the very slightly convex line on the mesial surface of the former is converted into a pronounced convexity in the latter, and the slightly concave line which bounds the distal side of the incisor in Class II is converted into a double curve in Class III. Then, as we pass from Class III to I, this double curve gradually becomes straighter until it finally disappears in the nearly parallel sides of the typically square tooth. In the two lower rows we see the working of the same principle in the laterals and canines. The mesial line of the lateral, which is most characteristic of Class II, is nearly straight, while its distal side is bounded by a line that is concave until it ap-

proaches the incisal edge which it joins by an abrupt curve. The lateral of Class III has this double line on the mesial side, while the distal side is strongly convex. As we approach Class III, the straight line on the mesial side gradually changes to a double curve, and the distal concave line becomes convex. Then the straightening of the mesial line in Class III gives the lateral of Class I, and a very slight modification of this form gives the lateral of the oval type. Laterals vary much in proportion of width to length, but there are no other types than these, and all other forms are incongruities or negligible variations. The canine of Class II has a narrow neck and its greatest width is nearer the tip than in other forms. That of Class III is the most rounded and graceful, while the form of Class I is very solid and thick at the neck. The canine best suited to the oval incisor is rather narrow and pointed.

In this chart (Fig. 21) I show you how the typal forms and their variations may be modified by increasing or decreasing the length of the tooth without changing the type. On the left of this diagram you see the three primary types represented in three rows. The middle row shows the teeth in medium length, the upper row in a longer, and the lower row in a shorter form, the type remaining the same in the three lengths. On the right of the diagram the same method has been carried through those variations of the primary forms which are the result of crossing. One result of this crossing is the oval tooth of Class IV, which never appears in the primary form. These variations shown on the right are better suited for general use than the primary forms, because in all mixed races the proportion of the severe primary forms which we find is small, and these severe forms are suitable for the severe types of faces only. The group on the right in the diagram is adapted to faces, the outlines of which are somewhat softened and blended by crossing. It is the working of one and the same law that produces the modifications in both teeth and face.

The facts that I am most desirous of getting clearly before you are that this system is a perfectly natural one, and

that all the methods by means of which it has been worked out are no other than such modifications of Nature's own methods of working as will lead us more directly and quickly to our desired end, and in that end give us more uniformly perfect results than are ever found in Nature. In methods and in results it is a perfected artistic compendium of all of Nature's work in teeth.

Let us now apply the principle of this class character to the other teeth of a set. The view now before you (Figs. 22, 23), shows the outline designs of twelve sets of fronts. The primary types are seen in the group of three in the upper left side of the chart, and we pass by three crossings or steps of modification to the group in the lower right hand corner. This represents the great-grandchild of the primary group. Here all the severity of the primary group has been softened. Each set has taken something from the character of the other, but please observe that the type still remains dominant in each one—you can see at a glance to which class each of the three sets belongs.

We will now carry our work a step farther, and show you (Fig. 24) three full sets in which the typal characteristics of each of the three primary types have been given to each tooth in the respective sets.

Select any tooth that you please in either of those sets, incisor, bicuspid or molar, and then compare it with the corresponding teeth in the other two sets. You will see that the character of the primary type in each set has been imparted to every tooth in that set. Each set is perfectly true to Nature, but each has more definite character than you ever saw in any single set of natural teeth. There is a more perfect harmony and balance of line between the different teeth composing the set than Nature ever produced. There are no discords in the flow of those lines.

Our position in this matter of design, in relation to one who produces artificial teeth by simply copying natural ones, may very justly be likened to that of the breeder of animals or the producer of new and improved forms of fruit. We are no longer blind followers of Nature, imitating her defects,

but intelligent selectors of principles and utilizers of her secret processes. We eliminate defects. We secure harmony. The finished results are, in very truth, more natural than any set of natural teeth *because harmony is the very first essential of naturalness.* We become the master of Nature instead of being her servant. We utilize everything that is vital and significant and eliminate all that detracts from perfection. Our one aim in all our work is the establishment of harmony between outline or form of tooth and outline or form of face. And we achieve that by the proper balance and curve of line in the tooth, in relation to the type of face for which it is designed.

If I state the problem in another way you will see at once that it is so. If the size and contour of a tooth is exactly right for a given face, then the harmony is perfect. But the "contour" of a tooth is only another name for the balance of line and curve in the tooth. If the lines and curves of the tooth balance or are in harmony with the lines and curves of the face, then the highest degree of perfection attainable has been reached. And we shall see that there is no difficulty in achieving that perfect result in all edentulous cases. Let us, then, now take up the consideration of the relations of typal tooth forms to facial contours. And in order to make the application of our new principle perfectly plain, we will begin with the outline diagrams of the four chief types of faces.

These outline diagrams show only the strong main lines of the faces, and thus we shall be able to see quickly and clearly the relation of tooth form to these lines.

All of the best writers that I know on the subject of physiognomy are agreed that there are but three well marked classes or types of human faces—the square, the oval and the tapering. But I think one strong type of face has been overlooked by all writers on the subject. It is the form which shows a greater width below the eyes than above. The whole lower part of the face is round and rather heavy, and the forehead is usually dome-shaped. I call this the ovoid face because it resembles the form of skull to which that name has been given. It is an ancient type of face and the skull which

represents it is found in the Barrows of Great Britain and on the Continent. It has probably sprung from Mongolian stock. No form of tooth has ever been made that is well adapted to this shape of face, but those of Class III in our system are perfectly suited to it. These four primary types of faces have several modifications which we shall consider as we proceed.

In the square face and in its principal modifications, that is to say, in all faces the sides of which are parallel or nearly so, we secure perfect harmony with the teeth of Class I.

If the face is typical or severe in its squareness, then we must use teeth the central incisors of which are parallel on their proximal sides. But the great majority of square faces are not of this type. Usually there is a slight converging of the lines from the forehead to the chin, and the teeth should therefore have lines which converge slightly toward the neck.[14]

The oval face is the result of a slight rounding of the angles of the square face. Exactly the same modification of the square tooth produces the oval tooth.

Again, in the ovoid face, our tooth outline follows the general contour of the face. The characteristic of this type of face, you will remember, is the width, roundness and heaviness of the lower part. This is the special feature of the teeth in Class III. The general character of the tooth of this class and the flow of all its lines correspond perfectly with the ovoid face. *In all of the foregoing illustrations harmony is secured by parallelism of tooth outline and face outline.*

The tapering face has a wider range of variation than any of the other types. It begins as a slight departure from the square face by the convergence of the cheek lines toward the chin and it presents every gradation of change from this to the extreme convergence seen in the very pointed chin.

In all faces of this character the lines of the proximal surfaces of the upper central incisors run in opposition to the lines of the face. If the lines of the face converge but little

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[14] In all that we have to say about tooth form, it is always to be understood that we are speaking of the upper central incisors. It is these teeth that are the chief factor in determining harmony with the face, and they also govern the type of all the other teeth in the set.

toward the chin the proximal lines of the teeth should converge but little toward the neck of the tooth.

The amount of line convergence in the face governs the amount in the teeth. If this line convergence is accompanied by rather full, round cheeks, then the disto-proximal surface of the upper centrals should also be rounded or convex. In selecting teeth for the tapering face of any degree you have only one principle to keep in mind, so far as tooth form is concerned, and that is that the contour lines of your upper incisors must be, in a general way, the reverse of what they are in the face. The observance of this rule will always give you perfect harmony—*the harmony of opposition of line.*

If I have now made clear the fundamental governing principle in the relation of facial contour to tooth form, we will rapidly pass in review a few photographs of the more striking and distinctive types of faces.

We will first examine the forms of teeth best suited to the square face and its immediate modifications, the shorter and longer face of the same type. I am taking these all together in three groups for a special reason. When we were looking at the teeth of the orang-outang you will remember I told you that teeth of the square type, or those with parallel sides, varied more in proportion of width to length than any others, and I added that as the same fact was observable in faces I had designed a special series of teeth to meet these conditions. This series is known as groups A, B and C in Class I as now shown on the screen. As all of the faces are of the same general type, differing only in proportion of width to length, so the teeth are of one type differing only as the faces do. The teeth are not of the most severe typal form. There is a very slight convergence of the proximal lines and a slight convexity of the disto-proximal surface. The reason for that is that there are but very few faces of the most severe, square, typal form and even for these the forms of teeth shown would be perfectly suitable. But there is a very great number and a very wide range of faces showing slight modification of the square type. It is to meet that wide range of face found in nearly all countries that this series of teeth has

been designed. There are, as you see, three lengths and five sizes to each length, making fifteen sets in all. I will ask your close attention for a few moments while I point out to you what it means to have a series of teeth of one model like this. In the first place, there is the very wide range of face in the long, medium and short varieties of the square type for which this series is perfectly suited. But its usefulness and convenience extends much beyond that. You have all had the experience of finding the exact type of tooth you wanted for a given case, but in a larger or smaller size than the case demanded, and you know the feeling it has given you to find that the model of tooth you wanted was not made in any other size than the one you could not use. Well, that situation can never occur in the system of teeth now suggested. No model will ever be brought out in one size only. That seems to me to be about the most senseless feature that can be charged to the old régime.

In this particular series we have five sizes in each group. But there is more than that in it. In all cases for partial plates the absorption following extraction makes it necessary to use a tooth longer than the adjoining natural one, yet you should have a tooth of the same general type. Suppose it is a case in which one central of the short series, No. 6, is missing. The space to be filled demanding a longer tooth of this type, you simply pass from group A to B in size No. 6 and find exactly what you require. If your standing natural central should be of medium length then you pass from B to C to get what you want. Now, if you will think for a moment what it means to have such a range of selection in a form of tooth for a great variety of the type of face most frequently met, you will, I think, see that this one series of fifteen sets is far more valuable for a dentist to keep in stock than twenty times that number of the heterogeneous moulds without system or relation as formerly made, not to mention any of the other very important points of superiority of the new models.

The short tooth of the series A is, of course, for the type of short face, shown in the lower row of the view on the

screen, the B series for the middle row, and C for the long faces of the upper row.

The arch of the teeth in the upper jaw of the short and medium square faces is the segment of a larger circle than would be required for any other type of face. A photograph of a set of natural teeth showing this characteristic arch is now on the screen together with a view of artificial teeth mounted for such a case. There is but little overlap of the upper incisors in this type of face and when the teeth become worn the bite is nearly square, especially in the short face. In the long face there is usually some overlapping of the centrals or laterals.

This group shows the first modification of the square face in the direction of the oval. It is, perhaps, more frequently met with in the United States than any other form. Teeth of B form, Class I, are also perfectly suited for the male face of this type, but for the feminine face I have designed and carved the four sizes of D, Class I. The greatest possible care was given to the modelling of this group of teeth and they have been designed to produce a perfect harmony with one of the finest types of the feminine face in America and England. Slight overlapping of laterals adds to the beauty and naturalness of appearance. The general appearance of the arch is the same as in the square face, but is a little more rounded at the front.

They have a slight rounding of the mesial and distal incisal angles. Slight overlapping of the centrals is nearly always found in the finest specimens of natural teeth of this type. There is a longer and a shorter modification of this type of face and if it is found to be present in sufficient numbers in any country to make a demand for a modified form of mould in this type it will be produced. The usual form of arch is shown in the photograph and the artificial teeth suitable for dentures.

The tapering form of face. The female type of this is the most delicate, and by many considered the most artistic form of feminine beauty. It is a type of face frequently found in Italy. Women with faces of this type were usually selected

by the great Italian masters as models for their representation of the Madonna, and it is worthy of note that this is the type of face depicted by the great English portrait painters of the late eighteenth century as that of the famous beauty, Emma, Lady Hamilton. All of the teeth in Class II, except mould A, have been designed for this form of face. The masculine face of this type, with converging lines, often presents very strong features. The lines of the cheek, from the malar bones to the lower jaw, although converging considerably towards the chin, are very straight and firm. For this type of face the teeth of Model A, Class II, have been made. There is no overlapping of the teeth in the strongest type of face of this class.

For the shorter tapering female faces in this class models have been designed, and also for the medium and longer tapering faces. In all of these types, particularly those with the sharper form of face, with a somewhat pointed arch, there is often more or less overlapping of both centrals and laterals, but especially centrals, as shown in the accompanying skull and models.

This is a group of the long tapering face and is, I believe, much more frequently found in England and some parts of Italy than in Germany or the United States, although many of the old New England stock had long faces. The teeth best suited to this type of face will be rather long, with converging proximal lines such as are seen in moulds of Class II. We sometimes find in faces of this type, in England, a rather short upper lip. In such cases, and, in fact, in all cases where we find a short upper lip combined with prominence of jaw, I think it better always to use short teeth or those of medium length.

But teeth with tapering proximal sides should be selected for all variations of the tapering face. The duplication and reversal of the lines of the face in the shorter lines of the teeth produces an effect of balance and harmony which a trained artist would perceive and understand in a moment. If the face is long and only slightly tapering, then the teeth of Mould A, Class I will give a good effect. In all tapering faces

with rather full cheeks the teeth in Class III are also perfectly suitable. Harmony is produced with these teeth, as with those of Class II, by contrast or reversal of line.

This is the type of face to which I have given the name "ovoid," and for which the teeth in Class III have been specially made. The greatest width of the face, as I have already pointed out, is in the region of the malar bones. But the entire lower part of the face is heavier than in any other type. The cheeks are full, round, and thick. Women with these facial characteristics are sometimes spoken of as belonging to the voluptuous type. The beautifully curved outlines and generally rounded character of the teeth in Class III will give the most harmonious and satisfactory effects in faces of this type.

Slight depression of the laterals gives that prominence to the canines which is in keeping with the strongest form of this face. With the more delicate and refined type of face of this class there should be overlapping of the laterals. The arch, as you see, is rounder than in any other type.

I have shown you how the bolder forms of teeth in the present system are adapted to the four typal forms of faces. The general application of the system to modifications of the typal faces can best be seen by exhibiting the table of classification, in which will appear the whole system in one view.

This table of classification presents three primary classes founded on the three primitive types of natural teeth. Each class contains a certain number of variations or modifications of the primary types corresponding with the variations in the primary types of faces. The more severe types of models, or those most closely resembling the primitive forms in natural teeth, are most suitable for the strong characteristic or typal forms of faces. In nearly all faces which result from the crossing of types we shall find one or other type dominant. Any given face will approximate to the square, the oval, the tapering or the ovoid form. We shall therefore determine the dominant factor and select our teeth accordingly.

It will be noticed that each class in our table of classification is composed of nine sections. Each section represents

all possible sizes of one model of tooth. The teeth in any one section are called a series, the only difference in all the teeth in a series being that of size. They are all precisely the same model, but in sizes to match variations in size of faces of the same type. This is an entirely new feature in the manufacture of artificial teeth. How often we have had the experience of fixing upon a certain shape of tooth, but which was either too large or too small for our purpose, only to find that no other size of that model was made. That, to my mind, has always been one of the most incomprehensible inconsistencies of the old order of things. The manufacturers of the present system will never issue a single size of tooth in any model without supplying others in that series as soon as they can be got out. Theoretically the sizes of the upper central incisors in all the series run 6.75 to 9.75 m.m. in width, the sizes advancing .25 m.m. at each step. But practically it is not probable that all of those sizes will ever be called for in any series. Three or four sizes in each series will meet nine-tenths of the demands. While on this subject of size of teeth perhaps I had better say that I think the chief determining factor in adapting size of teeth to face should be size of external mouth opening and other features rather than general size of face. Small teeth in a mouth with large opening, no matter what the size of face may be, will always look hideous. In our table you will see that a single series or mould constitutes the unit of the whole table. In each class there are nine of these units. It is not thought probable that there will ever be a demand for more than nine variations on any type of face. In some types, the oval, for instance, probably not more than three variations will ever be required.

You are beginning to see now the comprehensiveness, the completeness and the simplicity of this scheme of classification. There in that one table you have an arrangement that banishes all uncertainty and guesswork. A patient comes to you for artificial teeth. You first determine in what class the face belongs. If it is not a pure type you decide on the dominant feature and determine that it is a modification of the

square, the oval, or the tapering face. You then select your teeth on precisely the same principle. If it is a square face just passing into the tapering form, you select a tooth with slightly converging proximal lines and your harmony is perfect. Each set of teeth in a series is numbered and the length and width of the centrals and combined width of the six upper fronts is given on one line opposite the number. You therefore have under your eye every condition for giving you exactly what you want. All the old wearisome, vexing search among the miscellaneous collections of the trays is ended. You work quickly, positively, accurately, artistically, as scientific men should.

All of the teeth in Class III are in an entirely new field, as models of this beautiful type have never been made by any manufacturer before. And so far as my knowledge goes, only one model in Class II has ever before been produced. By classifying and systematizing the work I have therefore given you a far wider range of tooth-form than you have ever had before, and with comparatively few moulds.

And thus, you see, for the old vague, complex and bewildering effort at instruction in the adaptation of teeth to certain hypothetical temperamental conditions, which nobody ever understood because they never existed, we substitute a few simple, clear, positive rules, based on a fundamental esthetic principle. And the essence of that principle is the direct adaptation of tooth form to facial contour. A square tooth for a square face; an oval tooth for an oval face an ovoid tooth for an ovoid face, and teeth with proximal lines converging toward the neck for the tapering faces with lines converging toward the chin.

Gentlemen, in conclusion, let me call your attention to the fact that in dealing with this new classification of teeth in its application to artificial teeth I have made no mention of the very important work of Professor Gysi in the formation of the masticatory surfaces of bicuspids and molars, as these will appear in this new system of teeth. That work I consider equally important with what I have presented to-night.

Summary.

A brief summary of the facts and principles involved in this system of artificial teeth:

1st. This system is based on the new classification of the natural teeth which I have discovered, the essential feature of which is the three primary or primitive forms of the upper central incisors common to all races of men and the anthropoid apes.

2nd. By the crossing or combining of these primary forms every conceivable form of human tooth can be produced.

3rd. By applying a knowledge of design to the three primary forms of natural teeth a system of teeth has been produced in which all the lines and contours of any given set are in more perfect harmony and balance than we find in Nature.

4th. As the three primary forms of human teeth are common in all races, therefore a system of artificial teeth founded on these primary forms is equally suitable for all races of men civilized or savage.

5th. As investigation shows that there are but a few characteristic forms of human faces which can all be grouped in a series of a dozen or less, to which groups all slight variations in form may be referred, therefore a few forms or types of teeth, very carefully designed and modelled to harmonize with the more characteristic forms of faces, is immeasurably better suited to the production of natural and artistic effects in dental prosthesis than any number of moulds produced indiscriminately and without any knowledge of the above-mentioned fundamental facts.

6th. A close study of the relationship of the contour lines of the teeth and face has enabled me to design artificial teeth that will often be found to give a more perfect harmony with many faces than did the natural teeth of that subject, the reason for this being that the laws of heredity as exhibited in mixed races rarely permits a perfect harmony in the different features of the body.

7th. The arrangement of this system of teeth into classes and groups based on Nature and corresponding with the forms of faces for which they are designed, both being shown in illustrations placed side by side, enables the dentist, aided by the very clear and simple table of classification, to select the teeth best suited for any case with an ease, economy of time, and certainty of results never before approached.

ROSIN SOLUTION FOR THE SEALING OF THE DENTINAL TUBULI AND AS AN ADJUVANT IN THE FILLING OF ROOT-CANALS[1]

By Dr. J. R. Callahan, Cincinnati, Ohio.

℞ Rosin .... gr. xll
Chloroform .... ℨiij
M. Fiat sol.

Colophony, resin, commonly known as rosin, is obtained from turpentine by distillation. In the process the oil of turpentine comes over and the rosin remains behind. Rosin varies in color from dark red-brown to black or white, according to its purity and the degree of heat used in its preparation. Chemically, it is the anhydrid of abietic acid. It has the physical and chemical properties common to all resins. It softens at 176° F. and fuses completely at 275° F.; is insoluble in water; with difficulty is soluble in alcohol; freely soluble in chloroform, acetone, benzone, and fatty oils.

The rosin that is best adapted to dental uses that I have been able to find, is that prepared by Bernardel for the use of the violinist. A French preparation very near the color of dentin. The formula as given above makes a very thin solution. It required a long time for me to realize the advantage in the use of a thin solution. A thick mixture will not penetrate the tubules, nor does it give up enough chloroform to dissolve the gutta-percha.

You will agree with me in three statements:

First—That thermal changes due to the presence of large metallic fillings in tooth cavities excite conditions that cause the untimely death of many tooth pulps.

Second—That pulp capping has ceased to be a regular procedure in many offices.

Third—That a thoroughly satisfactory root-canal filling has not yet been proven.

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[1] Read before the First District Dental Society, S. N. Y., Dec. 1, 1913.

It is my desire to discuss the use of a solution of rosin in chloroform in our treatment of the class of cases that the three statements suggest.

A moment's consideration of the three divisions indicate that we are to deal with dentin that has been subjected to infection. Therefore a brief rehearsal of the histological anatomy of dentin will aid us in getting our mental eyes in the same focus.

Arthur Hopewell Smith in his late book, "An Introduction to Dental Anatomy and Physiology," says: "The functions of dentin are to give substance to the tooth itself; to provide a center of sensation; to protect the pulp. Enamel is without the pale of nutrition. The pulp is highly vitalized and the dentin is on the borderline of the living and the dead: semi-vitalized, if one may so speak.

"Nature would not for a moment tolerate the presence in the midst of living tissues of a dead body like enamel. The result is therefore the presence between the living pulp and the inert enamel of a large area, relatively speaking, of a tissue which is marvelous and unique. In no other part of the body do we find an entirely tubular structure like dentin. Its peripheral parts where it joins the inorganic enamel and cementum are less vitalized than its central parts. This explains the reason why the dentinal tubules are not of the same caliber throughout their lengths. They vary from 1.7 μ to 5 μ. The diameter of the tube diminishes as it proceeds outward, until at the peripheral region of the tooth it becomes immeasurable. The dentin of the crown of teeth is more plentifully supplied with living material (protoplasm) than the roots; hence the tubes branch more frequently in the latter than in the former situation. The tubes carry the dentinal fibrils; that is the peripheral poles of the odontoblasts."

It is through these dentinal fibrils that nervous stimuli are transmitted to the pulp. Following the teachings of Miller and Black in the study of carious dentin, we note among other interesting things that caries progresses along the lines of the dentinal tubuli; that the form of the disintegrated dentin is that of a cone with the apex toward the

pulp chamber, and that the dentin is decalcified in advance of the penetration of the micro-organisms.

It is not likely that in the preparation of cavities we *always* remove the apex of the affected dentin. In deep-seated cavities is it advisable? In spite of the application of strong antiseptic agents recurrent decay may develop, and toxins finally reach the pulp.

If the remaining traces or thin layers of decayed dentin can be thoroughly dehydrated, the application of rosin solution may be of great service.

First, rosin being more or less a non-conductor, it reduces the shock of thermal changes, thereby lessening the tendency to secondary growths or deposits within the pulp chamber that are so noticeable under large metallic fillings, especially under large gold inlays.

We are taught that the decalcified dentin that is to be found just in advance of the micro-organisms in carious dentin furnishes food for the invading host. If the remaining decalcified dentin be saturated with rosin, I imagine the cost of living in that region will become prohibitive. However, if the rosin solution reaches the farthest boundaries of the decalcified dentin through the infected area, then the micro-organisms within the tubuli will have been engulfed within the rosin solution, and unless the bacteria are able to liquify the rosin, they will be forever inhibited from further activity, be they arobic or anerobic, in active or spore form. I need only mention the antiseptic properties of the chloroform.

This you will admit would be a very desirable condition in which to have a layer of decayed or decalcified dentin over the pulp, where the removal of the layer of decay would mean the exposure of the pulp.

The most satisfactory results that I have had in capping pulps has been to flow a rosin solution over the exposure, evaporating the chloroform with warm air, then cause a very thin cement to *flow* over the floor of the cavity and the thin coat of rosin and allow it to harden, being very careful to avoid pressure of any kind on the cement until quite hard.

This practice has been confined to quite small and recent

exposures. Not the least satisfactory use of the rosin solution is after more or less thorough drying of the cavity and application of the rosin prior to the insertion of gutta-percha fillings either as a temporary or permanent filling.

On the removal of a temporary stopping of this nature that has been in place a week or a month, the decayed dentin that may have for any reason been left in the cavity will be found noticeably tough and hard and dry, due to the presence of the rosin, and the sensibility of the dentin will be materially less, showing that the dentin has been free from the irritating effects of acids, or, in other words, the fibrils have been in a state of comparative rest. And after all is said, the chief function of the surgeon is to remove the irritant and place the affected region at rest to the end that nature may perform a cure.

We now come to the consideration of the time-worn subject of root-canal filling. Let us not undertake to discuss the treatment of root canals preparatory to filling further than to say that no root canal is properly prepared for filling unless a fine paper canal dryer, as furnished us by the dealers, can be passed to or near the apical foramen.

In a devitalized tooth we are again dealing with infected dentin or with dentin in which the tubules will soon be filled with micro-organisms unless they be tightly sealed with a stable and compatible substance.

In a discussion read before the National Dental Association at Cleveland, July, 1911, recorded on page 218 of the official proceedings of that year, I gave the technic for filling of root canals with rosin chlora-percha and gutta-percha cones.

The record shows this statement: "A tooth treated in this manner *out of the mouth* and made into a thinly ground slide will show that the tubuli are filled to the cementum with rosin. The canal is filled with rosin and gutta-percha, a mixture that is hard and insoluble in body fluids, does not shrink and is compatible with the surrounding tissues, as is chloropercha."

Further along in this paper I wish to modify this statement somewhat.

Fig. 1

Fig. 2

Fig. 3

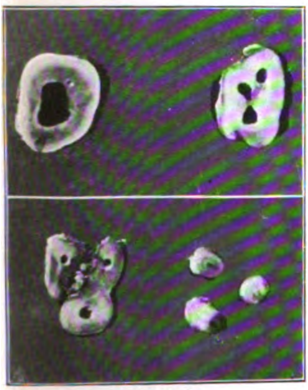

Fig. 4

Fig. 5

Fig. 6

Fig. 7

Fig. 8

For description of Figures see other side

DESCRIPTION OF LANTERN SLIDES.

Fig. 1. By Dr. Black, showing the dentinal tubuli filled with micro-organisms.

Fig. 2. Another of Dr. Black's illustrations showing decay following the line of the dentinal tubules. In the preparation of such a cavity for filling, the cavity wall would not be cut much, if at all, pulpward of the line drawn on account of the proximity of pulp tissue. This would leave a considerable area of infected dentin. If, after the application of the sterilizing agent, the infected area could be made dry and then flooded with the rosin solution and the chloroform then evaporated, leaving the rosin within the tubules, it seems to me that both the dentin and the pulp would receive greater and more efficient protection against thermal changes or further microbic invasion than if the cavity were filled without such treatment.

Fig. 3. Shows the palatine and one of the buccal roots of a superior molar tooth, which, after having been filled with the colored rosin solution and gutta-percha cones, was ground to a flat surface, showing the filled canals and the diffusion of the rosin solution throughout the dentinal tubuli. This slide is selected because it is about an average specimen. These slides thrown on the screen show the rosin solution within the tubuli in blue color, the depth of the blue color depending upon the amount of rosin solution within the tubuli: the caliber of the tubules depending largely upon age and inflammatory conditions to which the tooth may have been exposed prior to the death of the pulp. This cut also shows areas in which the tubules were open to the cementum, and in the adjoining areas there seems to have been no penetration of the solution. It will be noticed that the solution always seals the pulpal or larger ends of the tubules.

Fig. 4. Transverse sections of a superior molar. The microscope shows that the dentin extends to the apical foramen in this tooth.

Fig. 5. Root canal filling of bicuspid tooth. If a root canal be filled with gutta-percha, and the tooth is then suspended in a 50 per cent. aqueous solution of hydrochloric acid, about the third day the whole tooth will be dissolved and fall to the bottom of the tube, leaving a gutta-percha model of the root canal. The same thing happens when the canal has been filled with the gutta-percha and rosin solution in combination, except that when the tooth has been saturated with the rosin solution it takes from seven to fourteen days to dissolve the dentin.

Fig. 6. Shows in detail the irregular shape of the canal of a canine tooth along the borders of the very thin fins on the right and left sides of this model: small clear beads of rosin will show in the X-ray pictures unless the rosin solution and gutta-percha have been thoroughly mixed.

Fig. 7. The root canals of superior molar tooth. In the palatine root a false pocket has been made with a drill. These canals were filled as per directions given in the paper just read. The forty to sixty pumping motions followed by the packing, with instruments, in each individual canal has caused the semi-fluid to find and fill the true canal as well as the false pocket made by the drill in the palatine root.

Fig. 8. Four canals in a lower molar. The drill did not reach the end of the fourth canal, but the filling material did. Attention is called to the gutta-percha cones that have found their way to the foramen: along the body of the canals they are surrounded by the semi-liquid rosin-chloroform and gutta-percha combination.

In the two years that have elapsed, almost constant observation and effort has produced improvement in technic and results. The improvement and better understanding of conditions is the result of having found a staining material that will carry with the solution into the tubuli and remain permanently with the rosin during the process of grinding thin sections of the dentin for microscopic inspection.

If possible, is it desirable or necessary that the tubuli be sealed?

Dr. Hermann Prinz, whom I regard as one of the foremost among our scientific research workers, said in a paper read before the St. Louis Dental Society, September 2, 1912: "If the canal is not filled perfectly, serum will seep into it from the apical tissues. The serum furnishes nutrient material for the micro-organisms present in the tubuli of a primarily infected root canal."

The dentin is traversed by dentinal tubuli which number from 25,000 to 30,000 to the square millimeter. The pulp in situ sends protoplasmatic processes into these tubuli, and is connected with the peripheral tissues by arteries, veins, and nerves which pass through the main foramen and a number of small foramina (usually 2–7) present in the apex of the tooth. According to Fischer these accessory foramina are found in about 90 per cent. of all permanent teeth. These anatomic facts are not sufficiently emphasized at present. Their significance is of great importance for the full comprehension of the pathology of secondary infection.

In an incipiently infected root canal, these dentinal tubuli and the small foramina offer ready hiding places for various forms of pathogenic bacteria.

After exhausting the nutrient material the bacteria become attenuated or they assume restive forms. If the tubuli and the foramina are tightly sealed, these enclosed bacteria must necessarily remain permanently confined in their lodging places, while, if the root-canal filling leaks, the seepage of serum furnishes fresh material which offers excellent opportunity for their renewed activities.

By continuity this secondary infection spreads along the

lines of least resistance, *i.e.*, toward the apex, and finally reaches the pericementum. This tissue protects itself against the invading foe by a reactive inflammation which results in the production of a fungus growth known as a granuloma, or, in the past, as the abscess sack or pyogenic membrane.

For years the enclosed bacteria may remain dormant. At the slightest provocation, however, overexertion, a cold, increased blood pressure, lowered vitality or some other cause, they may assume a most virulent activity, resulting in the production of the so-called subacute abscess. Based upon this supposition, we are able to furnish a plausible explanation of how these obscure secondary abscesses occur about the devitalized teeth which at one time were pronounced cured.

In one of the most profound papers given to the dental profession on mouth infection, Dr. Rhein says: "Unfortunately as a profession we must admit that most of the cases of blind abscess are the results of imperfect dental operations. In some cases they may be the result of bad judgment on the part of the operator; in others they may be due to ignorance and incompetence, but a very large number of cases are attributable to the failure of the educated dentist to give the time needed to perform an aseptic operation and have the field absolutely free from the possibility of future infection. This is absolutely nothing short of malpractice when done by a dentist who knows."

We have the testimony of several investigators to the effect that it is possible to sterilize the root canal proper, but it is an impossibility to sterilize infected dentin of a tooth while it remains in the mouth.

The microscope and the culture media have shown us conclusively that we have been, and are now, leaving enormous numbers of micro-organisms within the body with a more or less available route open to the circulatory system where they may reach any part of the body carrying destruction to those organs or parts that may offer the most attractive lodging place.

A most significant fact must be borne in mind in regard to the devitalized dentin. We have no blood current to assist in

the struggle. The dentin has absolutely no power even to assist in repair. No granulation or scar tissue—nothing but an inert tubular mass infected by millions of toxin-producing micro-organisms. We must make of this infected tubular mass an inert harmless and stable body, including the effective closing of the numerous foramina, to the end that nature may be able to envelop the root mass in a healthy and vigorous peridental membrane that the tooth may serve its several useful purposes for a number of years.

Most of us have at one time or another shared in the opinion that what the root canal might be filled with mattered but little.

The radiograph in the hands of the advanced dental practitioners has brought to light evidence sufficient to prove to the dullest of comprehension the fallacy of such an opinion. It does matter as to the material: it does matter as to the manner of placing the material in the canal. The matter of prime importance being the sealing of the more or less numerous foramina, and, as we have no assurance that all the foramina in a given root canal are located near the apex, it becomes our duty to seal the whole length of each canal with a material that will search out and seal minute canals or openings that, owing to physical conditions, we are unable to see.

Have we a root-canal filling material that will meet the requirements indicated above? We have three that may be considered. Gutta-percha and chloro-percha in combination, paraffin, as advocated by Dr. Hermann Prinz and Dr. Dunning and the combination of rosin and gutta-percha. With the gutta-percha cone and chloro-percha you are quite familiar. We know of many successes as well as of many unhappy failures with this root filling, sometimes due to faulty manipulation, but often due to the fact that the root-canal filling has shrunken sufficiently to admit body fluids to the canal or permit the egress of the micro-organisms that infested the tubuli, and in addition the gutta-percha root fillings are often found to be saturated with decomposed and odoriferous substances that we are altogether too familiar with.

The paraffin root-canal filling, as advocated by Dr. Prinz

and Dr. Dunning, has many attractive features, and time may prove it a most, if not the most, acceptable root filling. I have not always succeeded in getting the paraffin to the apex of the roots of upper teeth. If the wire is too hot the paraffin will collect about the shank of the instrument, and if not hot enough it does not flow to all parts of the canal. The melted paraffin will, however, follow the paraffin oil into the tubuli and foramina if treated properly. It will take time to prove its permanence within the body. Our previous experiences and the experience of the surgeon have made us a little shy on this point.

The technic of the rosin-gutta-percha root filling is simple, easy, quick, and sure to seal all tubuli and foramina that are open.

I have said that a root canal should be the general shape of the paper root-canal driers as furnished us by the dealers. In addition to this general form, have the mouth of each canal a decided saucer shape. This will facilitate the placing of agents or instruments to or near the apical foramen. The first step then is the complete dehydration of the dentin, using acetone, as advised by Dr. Prinz, as the dehydrating agent. After flooding the canal with acetone, use the paper points liberally until the canal is entirely free of moisture. Follow this with warm air. Then hold a warm wire in the canal for a minute or two, being careful that the wire is not hot enough to scar any part of the canal.

Right here is where many root-canal operations fail. The canals and tubuli must be as dry as it is possible to make them, bearing in mind that it is possible to do damage by overheating the root.

Now flood the dry root canal with the thin rosin solution, pumping it in with a wisp of cotton on a broach. When the canal is full of the solution, pass a fine wire or broach to the end of the canal. Work out all the air that may be trapped therein. This is of vital importance.

Select a gutta-percha cone that will reach to or near the end of the canal, holding the cone with a fine foil carrier, and pass the cone carefully and surely about half way into the

canal, pumping the cone up and down in the canal usually from forty to sixty times, and, as it dissolves in the chloroform, advancing the cone farther toward the apex.

The pumping motion forces the rosin solution farther into every opening. The chloroform at the same time dissolves the periphery of the gutta-percha cone which, becoming more and more attenuated, slips farther toward the apex, surrounding itself with a mixture of gutta-percha and rosin. The rosin seals the tubuli and at the same time causes the gutta-percha to stick tight to the pulp walls, and makes the gutta-percha more stable and proof against the action of body fluids or substances.

If this does not leave the large end of the gutta-percha cone at or near the end of the canal, place a small cone alongside or on the first one; then, with cold steel plugger points that will go into the canals, gently pack the mass into the canal, using warm air to soften the protruding gutta-percha if necessary.

This packing forces the semi-fluid (chloro-percha and rosin) into unknown canals and pockets, and at the same time brings the surplus chloro-percha to the mouth of the canal, where it may be taken up with absorbent rolls or cotton.

In multi-rooted teeth complete the filling of each individual canal before starting another.

Rub the steel plugger points on paraffin cake to prevent the partially dissolved gutta-percha from adhering to the instrument. The pulp chamber is to be filled with one of the cements.

You may ask: "Do you succeed in filling *all* canals and tubuli to the farthest extremity?" No; only those that are open and dry to the farthest extremity.

Are we likely to have inflammation in the periapical region following the closure of root canals in this manner?

The probability of inflammatory conditions in all cases depends upon the ability of the operator to read the pathological signs of each individual case and his skill and delicacy of touch in the manipulation of the various agents used.

Rosin and chloro-percha and cone is superior to chloropercha in three ways. First, the rosin in chloroform pene-

trates deeply into the tubuli and foramina that chloro-percha will not enter at all, leaving within such tubuli or foramina, upon the disappearance of the chloroform, a more or less solid, inert, insoluble substance that enmeshes the contents and seals the lumina of such tubuli or foramina. Second, the rosin and chloroform causes the gutta-percha, in whatever form it may be applied, to adhere closely to the walls of root canal or cavity. Third, the incorporation of the rosin in the freshly made chloro-percha makes an unshrinkable and impervious mass about the gutta-percha cone. If gutta-percha and rosin be dissolved in chloroform and left in an open dish or tube to dry or solidify, the rosin will rise to the surface and harden in a crust over the gutta-percha. When the mixture is made in the root canal, as has been suggested, the rosin in solution is held firmly in place in the dissolved gutta-percha between the canal wall and the cone in the center.

We must be prepared to meet all sorts of morbid anatomical changes in the pulp chambers, root canals and the dentinal tubuli, due largely to constructive irritations long present in and about the tooth.

The slides that I shall show on the screen are selected, each one, to assist in demonstrating that the teeth which require root-canal treatment are, as a rule, far from being the perfect anatomical specimens that we see illustrated in our text-books. A tooth that has lost its pulp has usually been subjected for a long time to those conditions that bring about destructive as well as constructive changes.

The rosin solution does not show in X-ray pictures until mixed with gutta-percha, when it shows very plainly in the canals and foramina, but not in the tubuli. Chloro-percha will not enter the tubules; bismuth oxide does not dissolve in chloroform, and therefore does not enter the tubuli; the blue stain spoken of enters the tubuli with the chloroform and rosin solution, but does not show in X-ray pictures; so, in order that we might have some visible evidence of the diffusibility of the rosin solution through the dentin, I have resorted to color photography.[2] To vouch for the correctness of the pictures, I have the original specimens here for comparison.

[2] See frontispiece.

One better versed than I in laboratory technic could certainly work out a more satisfactory scheme than this.

The pulp canals of a number of extracted teeth were opened mechanically—that is with burs and drills—dehydrated and pumped full of the rosin and chloroform that had been stained blue. Then the gutta-percha cones were used as has been described above.

I do not claim that this procedure gives an exact reproduction of conditions in a tooth canal while the tooth is yet in service in the mouth. I do claim that the specimens and the pictures give a clear and understandable *basis* from which we can work toward a reasonable ideal.

These slides are shown more to explain the theory than to prove results. There is a vast difference between filling a root canal in an extracted tooth and one in situ.

SOME REMINISCENCES AND EXPERIENCES[1]

By William Jarvie, M. D. S.

It is with a good deal of diffidence and shrinking that I commence to address you tonight, for I realize that to tell you some of the reminiscences and experiences occurring during my many years of dental practice, the talk must necessarily be largely about myself, and that may possibly prove to be a subject much more interesting to me than to you or to anybody else. So I pray you to judge me leniently in this regard and please to remember that I am doing it on your invitation, and that it is something from which I shrink. I would much rather talk with you about the weather, of which lately so much might be said; or the Panama Canal or of golf. Again, I am still residing at my country home, where I have had no books, papers or memoranda to refer to, and what I have written can be truly said to be the *recollections* of a long and busy dental life.

When I was fifteen years of age, I was an ambitious youngster, and wished to leave school and go into business. My desire was to become either a banker or a merchant, but my father wished me to continue at school. After some persuasion he yielded to my importunities, as far as leaving school was concerned, but he had views other than mine as to occupation. He had a friend who was a dentist, who had been very successful, had a fine practice, and who wished me to go with him; and my father seconded this wish. I demurred, as what little experience I had had with dentists was not pleasant (having had one or two teeth extracted), but I finally acquiesced with the unexpressed thought that I would thus have my way about leaving school, and after a short time be able to quit dentistry, and take up some congenial occupation. How little we know sometimes what is before us. I entered upon dentistry as a means of leaving school, and with a firm determination to continue in it but a very short time; but

[1] Read before the Metropolitan District of the Massachusetts Dental Society, October 15, 1913.

it became my life work, and I remained in its practice for fifty years, and until I retired seven years ago.

There were but two dental schools in the country at that time, the Baltimore College of Dental Surgery, organized in 1839, and the Ohio Dental College, organized in 1845. Two other dental schools had been organized, but they had gone out of existence.

These schools had but a two years' course of about four months each. Think of it! Eight months tuition deemed sufficient to teach what was then known of dentistry. It was generally considered that to become a student in the office of some able practitioner was a much better medium to become grounded in the principles and practice of dentistry than to enter a dental school of those days. So on October 15, 1856, I entered the office of Dr. A. A. Wheeler, 58 Court Street, Brooklyn, and was regularly indentured as an apprentice to learn the occupation of dentistry, which apprenticeship was to continue until I was twenty-one years of age, and as I was only fifteen at the time, you will see that it was to continue for five years and nine months. I was not to receive any remuneration for the first year and nine months; the following year I was to receive one dollar a week and each year thereafter I was to receive one dollar per week advance over the year preceding, so that during the year preceding my becoming twenty-one years of age I was to receive the munificent salary of four dollars per week.

At that time there was much more laboratory work to be done, that is there were more artificial teeth inserted, very many more than there are today in a practice of the same class. For then it was figured that fifty per cent of the annual charges were for artificial work. A much larger percentage of teeth are now saved for the life of the patient than was the case then. More well-to-do and cultured elderly people wore artificial teeth than they do now. At present comparatively few in the class I have just mentioned are edentulous in either jaw and still fewer are edentulous in both jaws, while at the time of which I am speaking it was quite general.

I was kept occupied in the laboratory making sets of teeth upon silver and gold plates, rubber at this time not being used. I enjoyed the work, or rather I was ambitious that the work going out from our laboratory should present as fine a finish and appearance as I was capable of.

When I was eighteen years of age, I had a disagreement with my preceptor. Although my salary had been but one dollar a week for the past year, I did not receive this regularly; it was just at the time I was to begin to receive two dollars a week, and in settling up with him for the past six months, he deducted two dollars for the two weeks vacation I had had in the early autumn. As it was no uncommon thing for me to work one or two or even three evenings in the week until 9 o'clock, for which I received no compensation, I did not consider this fair and I told him so. He retorted that if I did not like it I could leave him. I reminded him of that legal document indenturing me to him, which by the way, was of a most iron clad character. He became very angry and said I need not feel bound by it, and he would gladly release me. I was only too glad to be released and I left him, happier than I had been in many a day.

A short time before, my parents had left Brooklyn and gone to reside in Boston, and I joined them in January, 1859. Almost at once I was fortunate enough to be able to enter the office of Dr. W. W. Codman; and to show the condition of things existing in the profession, or particularly in Boston, at that time I had to pay him $500 for the privilege of studying in his office. I was quizzed once a week by him upon subjects which he had given me to study, was present in his operating room from time to time and watched his operations, and made myself generally useful in the laboratory.

Under his direction I filled hundreds of cavities in teeth which had been extracted, with tin foil, until I considered myself quite an expert. Whatever conceit I might have had soon left me, however, the first time I attempted to fill a cavity in the mouth. The conditions were so very different. While in my hand the tooth was not sensitive and I could so change its position that the cavity was always accessible. Also it was

always dry and the lips, tongue or cheek were never in the way. But in the mouth what a different experience! The patient was nervous and very sensitive to pain, the cavity was between the lower bicuspids and to me very inaccessible; saliva seemed to flow in great quantities and from every direction, the foil would not stay where I put it and at the end of the operation, a very imperfect one as you may imagine, the patient was exhausted and my back was aching so that I can almost feel it yet. After being with Dr. Codman for two years I was promoted to be his assistant and had a chair and operating room of my own. Let me here say a word of tribute to this man as a slight token of the regard and esteem in which I held him. Dr. Codman had a high sense of honor. He was quiet and unpretentious in his manner; was a fine mechanic, and had a keen sense of the artistic in his modeling and coloring of artificial teeth, so that they might harmonize with both the features and the complexion of the wearer. He had a most even disposition, and ever treated me with the utmost kindness and consideration.

Dr. Codman never used anything but soft gold foil and tin to fill cavities, and while he did not get the artistic results in cases where restoration of contour was desirable and which later was obtained with cohesive foil, the work was thoroughly done, and the teeth he filled rarely needed refilling. All the pluggers and excavators used in the office were made in the laboratory, and the experience I thus gained in manipulating, shaping, and tempering steel proved of great value to me all through my professional life.

All the artificial teeth used by Dr. Codman during the four years I was with him were also made in the office. The entire process of manufacture from the lumps of quartz and feldspar as large as one's fist to the finished product in the mouth, was carried on there. Every tooth used was made for each particular case; the body was ground, the teeth were carved, baked and set up with especial reference to the mouth in which they were to be worn. To my mind the result was much better as to strength and adaptation to the case than the great mass of artificial teeth inserted today. Notice please,

I say the *great mass* of artificial teeth which are inserted today, for I know full well that there are many of our progressive dentists, who in cases of the restoration of one or a few teeth, insert on roots or on bridges teeth which are carved and baked for the particular case in which they are to be used.

It might interest you to hear of some of the incidents connected with the introduction and the early efforts to make artificial teeth of mineral constituents; for you know, of course, that sets of artificial teeth up to about the year 1820, were made of the ivory of the hippopotamus. This was used in preference to any other ivory because a cross section of this animal's tusk is nearer the outline of a set of human teeth than any other form of ivory known, thus the outer shell of the tusk, or rather the cross section of it which is the hardest part of the ivory, would be carved to represent the teeth, while the inner part would be so carved as to be fairly well adapted to the form of the aveolar ridge and the palate. I have seen, as doubtless others present have, many sets of teeth which were made after this fashion and which had been worn for years with more or less comfort. Sometimes one or two or even three missing teeth were replaced by other human teeth, or by the teeth of sheep, they being set on plates of ivory.

When I was sixteen years of age I became acquainted with a Dr. Francis, then having an office in Myrtle Ave., Brooklyn. He was eighty-two years of age and had practised dentistry in Paris and in this country and was at one time associated with the dentist, Greenwood or Wolfendale, who had made teeth for George Washington. Among his treasures was a set of teeth carved out of ivory, which had been worn for some time by the "Father of his Country." I have had this set of teeth in my hands many times, they seemed to have a fascination for me and I never visited him without asking to see them. Dr. Francis had many other interesting specimens of sets of teeth carved from ivory and I always carried away with me on my leaving him, some souvenir of dental interest. I had always supposed him to have been a Frenchman until one day he made reference to something

which had happened to him in Ireland. I remarked that I had not known before that he had ever been there, when he replied, " Oh, yes," with a strong brogue which I had not heard from him before, "I was a poor divil when I first saw Ireland; I hadn't a shirt to me back. I was born there."

But I was about to say something of the introduction of mineral teeth into the United States, and particularly into Boston. About the year 1820 Dr. Henry W. Villers came to this country and brought with him some teeth he had made of minerals. Incorruptible mineral teeth, was the term used to describe them. Soon afterwards Dr. Villers came to Boston and sold the secret of his process to Drs. Harwood & Tucker who were then in practice together here.

I have some of these teeth, but they are in a storage warehouse in Brooklyn, and packed away with some other things which I wish I could have had here tonight, and shown to you. They were in shape more like an elongated small bean then the teeth which we use today. The enamel was of the crackle variety, and the color was anything but life-like, but they were not affected by acids, and would not waste away or decay as ivory and the teeth of sheep would.

Dr. Codman was at this time a young man working in the laboratory of Drs. Harwood and Tucker, and with them became intensely interested in the improvement of the material and in the methods employed in making these wonderful teeth. The body for making them was ground upon glass slabs, but it was found that enough of the glass was worn off the face of the slab during the process of grinding to act as a flux, and so the body would not hold its sharp outlines during the process of baking, and the teeth would assume the bean-like form to which I have referred. Other substances such as marble, were tried for slabs upon which to grind the body, but without success. One day it occurred to Dr. Codman that a slab of quartz would solve the difficulty, and he set about obtaining one. He remembered seeing a few miles out of Boston as he had driven by, some large stones built into a farm wall which had appeared to him to be quartz. Procuring a wagon, he drove to this place, found the stones to

be quartz as he had supposed, and for one dollar, got permission from the farmer to carry away one of them, which he brought to Boston. He certainly had the quartz now, but how was he to get a slab cut from it? In the cellar of the house in which was the office, he rigged up a frame with a saw such as we used to see in stone and marble yards, by which a block of marble would be sawed into parallel slabs. He used to work this saw evenings and every moment of the day which he could steal from his regular work. But after weeks of toil he realized that quartz was hard, *very hard*, and progress was slow, until at last he gave up in despair of ever having a slab of quartz by any such process. But one day he found a marble yard in which was a set of saws operated by steam, and he made a contract with the owner of the yard to have his quartz boulder sawed into slabs. The quartz was so hard, the contract price so small, that the owner of the yard wanted to give up the job, but the desire for this slab was so great that Dr. Codman doubled the amount to be paid, and after months of effort got this quartz stone sawed into slabs. Grinding the body upon one of them solved the problem of retaining the form of the carved body during the process of making. For three years, I ground upon this slab all the body that was used in the office in the making of artificial teeth, and I came to have quite an affection for it. Dr. Codman promised that it should be mine when he ceased to use it, but I never got it, and do not know what became of it, but it would be a most interesting exhibit and should be in some museum, like that of the Harvard Dental School.[1]

I was four years with Dr. Codman as student and assistant, and I look back to that period as one of the happiest of my life. My office relations were of the most pleasant, and I formed close friendships that exist to the present day. I learned to love Boston, its ways and its people, and I have a quiet affection for it yet, which I know will last as long as I do.

Through Dr. Codman, I came to know some of the great

[1] Since writing the above I have learned from Dr. Moffatt, of Boston, whose father, Dr. Geo. T. Moffatt, was a student in the office of Drs. Joshua and Elisha Tucker, that the quartz stone was sawed into seven slabs, one of which is in his possession and that five others are in the possession of other dentists in Boston.

pioneers of dentistry in this city. These men were quite elderly then and at about the close of their dental career. Among them were: Dr. Harwood, whose office, I think, was then on Summer Street; Drs. Joshua and Elisha Tucker, whose office was on Boylston Street, a few doors west of Tremont Street; and Dr. Keep, whose office was on Tremont Street, a few doors north of Boylston Street. Dr. Codman's office, I might say in passing, was on the north side of Boylston Street, the second dwelling house east of Tremont Street, and until a few months ago was the only building on Boylston Street, remaining unaltered and as it was fifty-four years ago.

The leading dental supply house was that of Codman & Shurtleff, B. F. Codman the head of it being the brother of Dr. W. W. Codman with whom I was. Their place was on Tremont Street, a few doors north of Beacon Street. The S. S. White Company had a depot here also, but their stock of supplies was quite limited.

Boston may well be proud of the men I have mentioned. They were all graduates of the Harvard Medical School, were men of education and refinement, and highly respected in the community. They were men of influence, they had been successful in gathering a large clientele, and were all very comfortably off as far as this world's goods go.

In the early part of 1863, I spent two weeks in Brooklyn, and during that time had many opportunities of attending dental society meetings, of becoming acquainted with some of the leading men in dentistry who were practising in New York and Brooklyn, and of seeing many of them operate. It was just at a time of great activity in dental progress. The dental atmosphere seemed charged with new life and movement. The use of cohesive foil and the mallet was well under way, dead pulps were being removed, roots being treated, and pulp canals were being filled. I was young and impressionable, and returned from my vacation full of enthusiasm, and filled with the desire to accomplish some of the things I had seen done while I had been away. This wave of progress did not seem to have reached Boston, and methods which all at once, seemed to me to be behind the times were yet in

vogue, and practised by the leading dentists. Just at this time I received a very urgent offer from one of the leading dentists in Brooklyn to associate myself with him as a partner, and the influence of my recent visit being still upon me, I accepted his proposition, and in March 1863, I went back to Brooklyn, and continued to practice in that city until my retirement seven years ago.

I entered at once upon what was a fair practice for a young man, and without delay was thrown into active participation in the work of dental societies, and also was brought into close association with dentists of middle and mature age, who were then the leading men and the leading minds in the dental profession. I have always deemed myself most fortunate that while quite young I had the great advantage of not only having the acquaintance of men whose dental reputation was world-wide, but from time to time I was permitted to see them operate and was frequently a guest at their table in their own homes. Among these were Dr. William H. Atkinson, who was the most active spirit in dental progress at this time. In appearance he was unusual. He had a large full face; he wore his hair, which was rather thin and ringlety, quite long; he had a full beard which partook of the same character as the hair upon his head, and which he allowed to grow half way down to his waist. He had a most vigorous manner in anything upon which he was engaged. He seemed to put mind, soul and body into whatever he was doing. I have seen him putting No. 120 gold foil, or rather rolled gold, into a large cavity in an incisor tooth and having it hammered home with a heavy leaden mallet, restore a broken off corner, and being so engrossed in the work that for the time he seemed to have lost all consciousness of the patient, or his or her discomfort. The result of his operations was ideal, but the manner of his performing them left something to be desired. At society meetings he was a frequent speaker and he had a most wonderful flow of language. His utterance was rapid and many of the words he employed were often beyond the comprehension of his hearers. He was most urgent that dentists should study more about the va-

rious diseases of the mouth, and dead pulps, alveolar abscess, pyorrhea alveolaris, necrosis, etc., were treated much more intelligently and effectually on account of his efforts. He was an enthusiast, and sometimes his enthusiasm carried him beyond the bounds of wisdom; and it was not always safe to follow where he would lead. He was big hearted and kind and ever ready to help a younger practitioner with a difficult or obscure case. I have known him more than once to break an appointment with one of his patients, and in answer to a telegram, there being no telephones in those days, come over to my office and clinic upon a case of necrosis or some other diseased condition of the jaw, before half a dozen dentists who had gathered to see him operate and learn from him. With all his peculiarities, I do not think that any other man has influenced the dental profession for good as did Dr. Atkinson.

There was Dr. T. B. Gunning, who at that time was most favorably known as the most successful operator in cases of broken jaw. He was sent for to Washington to set the jaw of William H. Seward, who was Secretary of State under Lincoln, and who was included in the same plot to be assassinated with Lincoln; but in his case the attempt to murder failed and only resulted in the fracturing of his jaw. It was my good fortune to have been associated with Dr. Gunning in reducing a fracture of the lower jaw, and I was very much impressed by the skillful manner in which he performed all the necessary steps of the operation, and I learned some things from him at that time which were of benefit to me during all the time I was practising. Beeswax was the only material that we had then with which to take impressions, and the manner of his manipulation of it and the results he obtained seemed wonderful to me.

There was Dr. E. J. Dunning, the grandfather of the present Dr. Dunning, of New York, whom you all know. Dr. Dunning was a well educated and refined gentleman. He had a large practice, and his clientele was among the very best of New York society. At the time I knew him he was about to retire from practice, and he had associated with him two or three younger men who continued his practice and continued

also his way of treating the teeth. Dr. Dunning was one of the ablest dentists of the old school. He used only tin and soft gold foil to fill teeth with. He was most expert, and inserted as beautiful fillings as could be inserted with this material and hand pluggers with smooth points. He could not be induced to adopt new methods and new appliances, and in his office cohesive foil, the rubber dam, the dental engine, and the mallet were never used. The result of Dr. Dunning's personality, the influence of his character, and the beneficent results of his method of caring for the teeth of his patients so impressed his associates that for many years after his retirement his methods were continued by them.

There was Dr. John Allen, of continuous gum work fame. Dr. Allen did more, perhaps, than any other one man to advance the art of restoring the natural contour of the face by means of artificial teeth. He made great improvements in the arrangement of these teeth, giving to each tooth its normal prominence in the natural arrangement of them. He was a genial gentleman, and enjoyed nothing more, after an exposition of what could be accomplished in the way of the restoration of the contour of the face where cheeks and lips had fallen in on account of loss of the natural teeth, than to remove from his mouth what would seem like a double handful of foreign material, and instead of the well rounded out face of a well-preserved man of sixty, we would see an old man with sunken cheeks and lips, and with jaw so wabbling that it was distressing to look at him.

There was Dr. William H. Dwinelle, then one of the most brilliant men we had in dentistry. He claimed to have discovered the cohesive properties of gold foil, and he certainly was among the first to make use of it. He devised many things to facilitate its use, both in the way of anchorages in badly broken crowns and in instruments with which to manipulate it. He was the first to employ screws fastened into broken down surfaces around which the gold could be built. He was a beautiful operator, and one of the very first to make contour operations. He was a very clear writer upon dental subjects, and read many papers before various dental societies.

There was Dr. John B. Rich, who lived to be nearly one hundred years of age, and died only three years ago. I have heard those who have seen more of his operations than I have, say that his fillings were the most homogeneous of any they had ever seen. Certainly they were beautiful to look at and perfect in their finish. He used small pieces of gold, his plugger points were small also, and every piece of gold was thoroughly consolidated before he introduced the next piece. Time seemed to be no object, and he occupied more than the usual amount of it to perform his operations. Dr. Rich claimed to be the first one to discover the absorbent qualities of paper in its use during operations upon the mouth.

Dr. J. W. Clowes was an advocate of the extraction of the sixth-year molars under almost all circumstances, and was just as pronounced in his advocacy of the retention of the wisdom teeth, claiming that they were the keystones of the dental arch, and that their removal would cause its ultimate destruction. He was also a firm supporter of the use of amalgam for filling teeth, believing it was the very best material for saving them. Certainly he was most successful in its use, and I have seen many fillings inserted by him, which after several years of service were as perfect at their margins as when put in. In later years he discarded the use of all other filling materials, employing it for small and large fillings alike. It was no uncommon thing for him to unite two broken down and loose teeth in the back part of the mouth with amalgam, thus securing a support for each other, and at the same time get a good masticating surface for an occluding tooth. He would also make bridges of this material, using cavities in the adjoining teeth to secure them in place. Dr. Clowes had a wealthy clientele, he devoted much time and skill to his operations, and his fees were about the same as other dentists would charge for similar operations where gold was employed.

Dr. Norman W. Kingsley has died within a year at the age of eighty-four. Dr. Kingsley was a man of great ability, and who had a great versatility of talent. He it was who invented the obturator by means of which those born with

the awful affliction of a cleft palate were enabled to speak and enunciate distinctly. He also made great improvements in the means by which the malarrangement and malocclusion of the teeth could be overcome. He contributed a great deal to the literature of the profession upon these subjects, and his great skill as an artist enabled him to illustrate his papers and his talks in a most exact and artistic manner. Some of his pieces in marble were very fine, and had he devoted himself to this line of work I am sure he would have risen to great fame as a sculptor. Failing health demanded his retirement from practice, and in his later years he proved his skill as an artist by his wonderful etching on wood, done with a hot steel point.

Then Dr. Royal W. Varney was one of the most wonderful fillers of teeth the dental profession has ever had. He early demonstrated the value of "extension for prevention." He would cut away tooth substance far beyond where there was any probability of a recurrence of decay, and sometimes it would seem as though there would be little left of a tooth to fill, but with the electric mallet and gold foil he would build out until he got a reproduction of an almost perfect tooth, and this would be left with a finish as smooth as the enamel itself. Dr. Varney practically gave up his life to this work, for he was not at all robust, and the tax upon his vitality in performing these long and exhausting operations proved too much for his strength and he died comparatively young, but many of his fillings are living to-day and testify to his ability and thoroughness.

In Philadelphia there was Dr. J. H. McQuillen, father of the present genial Dr. D. N. McQuillen, who was a man of great intelligence and ability. He was especially active in all scientific research work connected with our profession, and earnest in his endeavors to make the meetings of dental societies of greater interest and value. He was generally present at meetings held in Philadelphia, New York, and Boston, and always took an active interest in the discussion. He was a warm friend and frequent companion of Dr. Thomas B. Hitchcock, of your city, and when these two men passed away in

the full strength of their activities, the cause of dental science suffered a great loss.

There was Dr. James E. Garrettson, tall, erect, and scholarly. He was a fine surgeon and, as far as I know, the first man to give up his dental practice to devote himself entirely to surgical operations upon the mouth and head. It was always a pleasure to listen to him at dental society meetings; he employed simple language and made everything so clear that the most ordinary mind could understand him.

There was Dr. W. H. A. Bonwill, one of the most inventive genuises we have had in dentistry. He it was who invented the electric mallet, he made many modifications in the dental engine, he devised an articulator which has been extensively used, and many other appliances which have been of use to the dentist. He was quite hard of hearing and somewhat impatient with those who could not readily see as much value in his inventions as he did himself.

Dr. J. Foster Flagg was a most enthusiastic man with a ready pen and a marvelous flow of language. He it was who said " that in proportion as teeth needed saving, gold was the poorest material to use." He advocated the use of plastics, preferring gutta percha above all others.

But I must not weary you. However, I cannot omit to briefly mention a few more men of this time whom I knew and whose influence was felt throughout the profession. There were Drs. C. A. Kingsbury and T. L. Buckingham, of Philadelphia, and Dr. Robert Arthur, of Baltimore, who was the first one to receive the degree of D.D.S. He it was who advocated and practiced the Arthur method of separating teeth which consisted of filing a V-shaped space between the natural teeth to prevent decay where it was the most likely to occur—viz., at their point of contact. Dr. Edward Maynard, of Washington, was a most able dentist with a large clientele among the most celebrated men at the Capital. He made many inventions, among them being the Maynard rifle, which was in use by the United States army. There were also Dr. Jonathan Taft, of Cincinnati; Drs. W. W. Allport and George H. Cushing, of Chicago; Dr. J. G. McKellops, of St.

Louis; Dr. Amos Westcott, of Syracuse, N. Y., and Dr. Corydon Palmer, of Ohio.

These men and many more I knew have passed away, but their friendship was an inspiration to me, and had a great influence upon my career. I always felt that it was due to them that I should prove myself worthy of their confidence, and their kindnesses, and that I was in honor bound always to put forth my best efforts to follow as far as possible their illustrious examples.

At the time I went to Brooklyn, cohesive foil was being extensively used, and many dentists seemed possessed to build masses of it upon walls so frail that they soon broke down, and operations which had been long, tedious, and expensive utterly failed of their purpose, and the use of this material and the restoration of contour fell somewhat into disfavor, owing many times, to the poor judgment exercised in the selection of cases, in the weakness of the retaining walls and the improper shape of the cavities, all caused by lack of experience.

The operations were long; for remember that at this time the dental engine and the rubber dam were unknown. Files, excavators, and hand burs or burs rotated by means of the jeweler's bow, were the only means used to prepare cavities. Cavities were kept dry during the filling process by all sorts of means, according to the originality or ingenuity of the different operators. One favorite method was for the dentist to request his patients to keep all their old handkerchiefs for him. These were very soft and adaptable, and with pads made with pieces of them laid under the tongue and against the cheek, most mouths could be kept dry for a long time. Remember that this was before the time of bibulous paper. I remember well a case my associate had in 1863: A lower second molar was badly decayed and broken down, but the tooth was a valuable one, and an effort was made to save it. One entire morning was occupied in its preparation for the gold. Another morning was occupied in putting in the gold, during which I assisted, malletting and manipulating the linen rolls and the cheek. At the end of this stage of the work, patient and operators were exhausted, and the trimming and finishing

of the filling were left to another day. In passing, I might say that this patient's mouth was under my care until his death—twenty-five years later. The fee charged for the operation was fifty dollars, and as the tooth did good service for twenty years, it may be said to have been a success. In after years, as I saw this same tooth from time to time, I felt sure that with the improved facilities and appliances I could perform the operation with comparative comfort to the patient and myself in two hours, and feel amply repaid with a fee of one-half of what had been paid.

It has been well and truly said that "Necessity is the Mother of Invention." Such operations as I have mentioned called upon the inventive faculty, with which so many of our intelligent dentists are highly endowed, to provide means by which the flow of the saliva could be controlled, and that which did collect in the mouth could be drawn off and the teeth being operated upon so isolated that neither saliva nor dampness from the breath could reach the gold which was being introduced. About the year 1865, Dr. S. C. Barnum, who was a nephew and an associate of the Dr. Clowes I mentioned as such a wonderful manipulator of amalgam, conceived the idea of using sheet rubber for this purpose, and many and earnest were the demonstrations and discussions as to its utility. As Dr. Barnum introduced it the rubber was in pieces of about one inch square, and the one tooth to be operated upon was pushed through a small hole pricked in the center of it. The rubber was kept in place by an instrument carried in the left hand of the operator.

Many asserted that the thing was of no earthly value, for in the cases to which the rubber could be applied, the cavities could be kept dry quite as well without it, and in cases where the cavities were likely to get wet it could not be applied. My own experience with it at this time was that where I needed it, it became wet, slippery, and nasty. I tried it several times, and as often gave it up, but as often as I gave it up, I tried it again; for I knew Dr. Barnum very well and saw him often, and I determined that if he could use this appliance with benefit, why, I could use it also. In dental societies

about this time, we talked of nothing else. It was known as "Barnum's Rubber Dam," and for a time Dr. Barnum was foremost in its advocacy, and in devising improvements in the method of its application so as to enlarge its sphere of usefulness. The first improvement, as I remember, was the use of ligatures to hold the rubber in place; then the pieces of rubber were made larger—then more teeth than the one involved were included in its application; then metal clamps were used, and these early ones were very primitive affairs compared with the beautifully adapted ones now employed; then came saliva ejectors, or hand pumps, then pneumatic ones, until now we have the very complete method of keeping any tooth or any number of teeth dry for an indefinite period, and with comparative comfort to the patient. I may say in passing that a few years after the introduction of the rubber dam, one or two other dentists claimed priority of invention, but Dr. Barnum most certainly was the introducer of it, and the claims of these others were never recognized, while those who were in a position to know all the circumstances raised a sum of money and presented it and a watch to Dr. Barnum as a token of their appreciation of his great service to the science of dentistry. Soon afterward Dr. Barnum sank out of sight, and I doubt if many of the present generation of dentists know to whom they are indebted for this great help in their work.

A few years after this, in 1870 I think, a gentleman came into my office, carrying a good-sized grip. He told of a wonderful machine he had with which teeth could be drilled into and cavities prepared for filling in less than no time. It so happened that in my chair was a gentleman, in one of whose upper molars the pulp had died, and I was about to drill into it. The tooth was not decayed, and it was necessary to drill through a lot of sound tooth substance to reach the pulp chamber, which, in those days with the hand drill, was a long and tedious operation. I had this visitor set up his machine, and we tested it then and there. It was "Green's pneumatic dental engine," and the rapidity with which the drill made its way through dense dentin to the pulp chamber seemed

like magic. I was so impressed with the value of this new device that I would not allow the man to take it from my office. He protested, but I paid for the engine and became the owner of it upon the spot. This was the first dental engine I had ever seen or even heard of. It was wonderfully effective, but awfully noisy. It consisted of a foot bellows, connected with a hand piece by means of a rubber tube. The hand piece was shaped somewhat like the hand piece of to-day. The burs or drills being slipped into one end, while the shaft at the other end was attached to a fan wheel which was encased in a thin metal sheath with an opening at opposite sides. To one of these openings the rubber tube connecting with the bellows was attached, and the other was left open. The fan wheel was about two inches in diameter and about half an inch in width, and was revolved by the air being drawn through the opening against the fan wheel and down the tube by the action of the bellows.

This engine was a great boon to the dental profession, and made possible operations before perhaps thought of but unhoped for. The early history of this appliance which I have just described was in its way somewhat like that of the rubber dam as introduced by Dr. Barnum, in that it was very valuable, and a great advance and new departure from anything we had had before. At once improvements were made, pneumatic force was discarded as noisy and of comparatively little power, and within a year the Morrison engine was put upon the market by the Johnston Brothers, which had many of the features of the present foot-worked engine, and which is yet employed in places where electricity is not available. So rapidly were modifications and improvements made in dental engines that during the four or five years after their introduction I deemed it wise to get a new one each year, so as to get the benefit of the best to be had.

At the time I was studying with Dr. Codman the only way of replacing a lost tooth, except by means of a metal plate, was by attaching it with a wooden pivot to a natural root, and this was applicable only to the six front teeth. While some crowns thus attached did good service for a num-

ber of years, the usefulness of many was of short duration, caused either by deterioration of the wood, decay, and consequent weakening of the root, or, as very frequently happened, the splitting of the root brought about by the undue swelling of the wood. In 1877 one of my patients broke off the crown of an upper first bicuspid. The lady was very averse to wearing a plate, and at that time I knew of no other means of attaching a crown to such a root, so the space in her mouth remained unfilled. This annoyed me very much, as I saw the lady frequently, and I felt that it was a reflection upon the ingenuity of myself and of my profession that such a condition had not been overcome. I gave many hours of thought to the case, and one night while in bed the idea came to me how a porcelain crown might be attached to this class of roots. I got out of bed and wrote it down, fearing that by the morning I might forget it. The idea was this: to fit a metal pin into each of the two roots, fit a cap over the end of the root with holes punched so as to permit the protruding pins to pass through, drop wax upon the parts, withdraw pins and cap together and solder pins to the cap. Then grind a porcelain bicuspid to fit the space, back it with gold, wax it to the cap and pins, invest in the ordinary manner, and solder backing to cap and pins. The result was fairly satisfactory, but in the next case I had I used a porcelain cuspid instead of a bicuspid. I reported this case in February, 1879, to the New York Odontological Society, and the description of the operation and a cut of the crown appeared in the *Dental Cosmos* of June of the same year.

While this was a valuable advance in the art of supplying lost teeth where the root remained, it was very soon superseded by the work of Dr. Richmond, whose first invention was the supplying of lost crowns posterior to the front teeth with ones of gold. The crowns first inserted by him were made by fitting a band around the neck of the root or broken tooth, then soldering a flat piece upon the end. He would then melt pure gold into small globules and solder two, three, or four of these globules to the flat end of the crown, and thus form the cusps and grinding surfaces of bicuspids

or molars. At first he relied entirely upon the close and tight fitting of the gold around the neck of the tooth to retain the crowns in place. This was not always successful, although the force employed by him to drive them home seemed at times sufficient to drive the root and the attached crown into the head. I saw him do this many times, and I wondered at the fortitude of the patient. To overcome this tendency of the gold crowns to loosen and come off, he later conceived the idea of, after driving the crowns into position, drilling a hole through the grinding surface of the gold crown and into the broken crown or the root, and inserting into this hole a gold screw which firmly held the crown to the root. I was present at the first operation of this kind which he performed, but it was soon discarded for the one of fastening screws or pins into roots or dovetailing holes into broken crowns and placing cement into the gold crowns before putting them into place.

You know as well as I do the wonderful evolution which has taken place in the operation of replacing lost crowns by those of gold and porcelain since the ones I have mentioned, until crowns are now inserted so beautifully modeled and adapted as to defy the eye of an expert to detect them. And that is the culmination of artistic skill in dentistry; to so perform operations upon the teeth that the art itself conceals the art which has been employed, and I know of no one who has helped us to do this as much as my old friend, Dr. N. S. Jenkins, of Dresden. Through his efforts porcelain inlays were introduced, and are now made so life-like that, properly fitted and shaded, it is impossible to distinguish them from tooth substance. How very much better is such a substitute for lost dental material than the glaring masses of gold we see from time to time in the front of the mouth.

Just before I retired from active practice a new process was introduced which has had a greater influence upon the treatment of much decayed and broken-down teeth than any other device I know of. I refer to the Taggert method of casting gold. The engine and the rubber dam made possible and facilitated the preparation of decayed and broken-down teeth, which were filled and restored to their original form

and usefulness. They made operations practical and comparatively easy, which, without them, could not have been performed at all, and thus very many teeth were retained in the mouth which otherwise would have been lost. But even with these two great aids, many of the operations made feasible through their use were long, tedious, and exhausting to both patient and operator.

By the Taggert method these long and exhausting sittings are done away with, and castings are made to fit into large cavities and broken-down teeth with a perfection that is impossible in any other way. It was my good fortune to hear Dr. Taggert the first time he presented and demonstrated his method, and I shall never forget the impression he made upon me and the audience at large. As you all know, the use of these castings is not confined to operations upon the natural teeth, for in making bridges and in other operations this method has great possibilities. All credit to Dr. William H. Taggert, say I. He is an enthusiast in his work. He has devoted all his efforts and his means toward the perfection of this method, and so far has reaped no pecuniary reward. Whether Dr. Taggert was the first one to conceive the idea of casting gold or not, I am quite sure it is undoubtedly true that, had it not been for Dr. Taggert's ingenuity and persistent devotion to the perfection of his method, the dental profession and the public at large would have been without this most beneficent process of relieving some of the ills and burdens which the flesh seems to be heir to. Sometimes I feel as though I had retired too soon, for, had I continued to practise, I am sure I would have had much pleasure as well as comfort and satisfaction in its use.

When I allow my thoughts to revert to 1856 and dwell for a moment upon the conditions existing in the dental profession at that time, it seems to me like a dream. For instance the extraction of teeth was done in many cases by druggists and barbers. I remember well at the time I commenced the study of dentistry that on the next block and on the opposite side of the street was a barber's shop which had a sign in the window reading: "Cupping and leeching, and

teeth extracted here." Operations upon the natural teeth for their preservation and retention were quite limited. The cohesive property of gold was not generally made use of. Electricity was not employed. Vulcanite was not used at all, and the metals used as a base for artificial dentures were confined to silver and gold. While the *leaders* in the profession, men such as I have mentioned earlier—Harwood, the Tuckers, Keep, and Codman, of Boston; Gunning, Dunning, Benjamin Lord, the Parmleys, the Allens, Rich, and others, of New York; Garrettson, Flagg, McQuillen, and others, of Philadelphia; Arthur, of Baltimore; Maynard, of Washington; Jonathan Taft, of Cincinnati; Allport and Cushing, of Chicago; McKellops, of St. Louis; Westcott, of Syracuse—were all men of education and unusual ability, men of high social position and influence, and who would have been influential and leaders in any occupation they might have engaged in, the rank and file of the men practising dentistry were not so. Very many of them had little education and less refinement, and it was rather a reflection upon a man's social standing in the community to be known as a dentist. There were but two dental colleges in the country, and there had not been 100 students in them. Dental literature was exceedingly limited, and, if my memory serves me, was confined to two journals, *The Dental News Letter* and the *American Journal of Dental Science.*

Contrast these conditions with those existing to-day. Those entering the dental profession may not all be refined, but they must all be men of education, because the requirements for admission to the dental schools are of such a standard as to insure that at least. The rank and file of the dental profession are men of education and refinement, and are held in esteem by the community in which they live. Of course, there are exceptions, of whom none of us are proud, but so there are in the other professions; for that of law, medicine, and even the ministry are not free from very undesirable members.

By the use of cohesive gold, the rubber dam, the dental engine, the mallet, porcelain, cast gold inlays, and all sorts of

electric devices, we restore to natural appearances, use and comfort decayed and broken-down teeth, such as in 1856, and even much later, were condemned to the forceps.

We so treat dead and putrescent pulps that they need be no longer elements of danger, and alveolar abscess yields readily to intelligent surgical and medical treatment. That terror of the middle-aged and elderly person, pyorrhea alveolaris, need not now be the fell destroyer it used to be. Intelligently treated, a mouth can be kept free from its ravages, for in its early stages it readily gives way to treatment, and in cases where the disease is far advanced, under the care of educated, deft, and skillful fingers, accompanied by perfect aseptic conditions, teeth can be made firm and restored to usefulness and comfort. I don't say that even every intelligent dentist can accomplish such results in even the majority of advanced cases. It requires a man specially gifted with a fine sense of touch and a patience and thoroughness which comparatively few possess. I know that I did not have it, for, while ordinarily successful in the treatment of such cases, from time to time I had a case which I would refer to one who made a specialty of treating this disease, and with most satisfactory results—results which I am sure were more satisfactory than if I had treated the case myself.

There are now about fifty dental schools instead of the two which existed in 1856, and in place of the one hundred students in them, the dental department of the University of Pennsylvania alone has over 550 at the present time. There are now a large number of journals devoted exclusively to dentistry, and it would occupy more than one man's entire time to read all which is printed relating to our profession. Then there were not more than ten dental societies; now there are over four hundred.

The part which the dentist plays in the prevention and the treatment of disease is very great, and at no time has this been recognized as fully as it is the present day. So much so that many surgeons will not perform an operation, except in an emergency, without referring the patient to his dentist to have the mouth put in a thoroughly aseptic condition. It is

a very common occurrence now for a physician or a surgeon to consult with a dentist as to the condition of a patient's mouth, and the influence it may be having upon a certain ailment which the surgeon or physician has been called upon to treat. So different from what it once was.

You may remember, when I was referring to Dr. T. B. Gunning of New York, I told you that he was called to Washington to care for the fractured jaw of the Secretary of State, Hon. William H. Seward. When he reached Washington he was told by the Surgeon-General of the army, who had charge of the case, just what was to be done and how to proceed. The mode of procedure was not in accordance with Dr. Gunning's ideas, and he objected to proceeding in the manner the Surgeon-General wished. There was some discussion, and Dr. Gunning refused to proceed unless he could have the direction and control of the case. The Surgeon-General would not yield, and Dr. Gunning returned to New York. Some days elapsed, and Secretary Seward was not progressing satisfactorily; in fact, the fractured parts had not been got into position. Then Dr. Gunning was again sent for; a special train conveyed him to Washington, and the entire charge of the case was given into his hands. The broken ends of the jaw were brought together and held there, and in course of time the bone united and Mr. Seward recovered entirely the use of the jaw.

In cases of this kind occurring to-day the dentist or the oral surgeon would be called in at once and the patient given entirely into his care.

Last January it was my privilege at Chicago to listen while one of the celebrated Mayo brothers, the great surgeons, read a paper upon the influence which the condition of the mouth had upon a large number of diseases of the general system, and the important part which the dentist played in the care of the health of the public at large. Perhaps some of you were present, and I cite it in closing to call your attention to the importance of a higher and more thorough education of those entering the dental profession that they may the better understand the far-reaching influence of the territory upon which they specialize.

RESTORATIONS, WITH SPECIAL REFERENCE TO REMOVABLE BRIDGE-WORK[1]

By Charles F. Ash, D.D.S.

There is so much to consider under this head and so many things about which I should like to speak that one is at a loss as to where to begin, what to say and what to leave untouched. We have no desire to consider the methods of the man who is practising dentistry for revenue only, and in addressing you to-night, I feel sure I am speaking to a body of professional men whose idea of success is embodied in the attainment of the highest ideal.

The ideal bridge has not been made, nor it is fair to assume, has it yet been conceived; but that must not deter us from striving for something better nor from showing to our fellows such efforts as we may have made in our desire to advance even a step farther. It may be that your neighbor can take your idea and improve on it or from observing your principle he may be inspired with an altogether new idea. So, while your idea or mine may not in itself be any considerable advance over what we have had before, it may, nevertheless, be the father of a truly valuable and perhaps radical step in the right direction.

While listening to a very delightful sermon a few weeks ago, I was impressed with the applicability of some of the preacher's remarks to our every day work. He quoted from Paul's letter to the Philippians: "Brethren, I count not myself to have apprehended; but this one thing I do, forgetting those things which are behind, and reaching forth unto those things which are before, I press toward the mark." And so must we. If we see something which is better than that which we have, we must, in justice to ourselves and our patients, adopt it, and forget our old methods, leave the things which are behind, but not content with that, must press forward.

To devise better methods in our work, we must be pos-

[1] Read before the American Academy of Dental Science, Boston, Mass., January 7, 1914.

sessed of imagination and must let our imagination soar to any possible height; for the broader our vision is, the greater will be our achievement.

I feel more like writing a sermon on dentistry than describing the method of making any special piece of work, and I am going to follow this inclination in the hope that the younger men of the profession will be inspired to think for themselves in working out their success, and that the older men may feel it necessary to break away from many of their old and pernicious habits of practice, and seek newer and better methods of caring for the interests of their patients, that they may not be outstripped by the younger members of the profession and to the end that newer and higher ideals may be attained and still higher ones sought after.

Let us begin then with the question of diagnosis. The patient presents himself and complains of pain in a right upper bicuspid. What is the usual course of procedure? We find the cavity, treat it according to its needs, and dismiss the patient, or possibly if we see some badly broken down teeth in the mouth, suggest that there is other work to be done. Gentlemen, I maintain that you are not thereby assuming the proper professional attitude nor are you doing justice to your patient. It is your duty to tell your patient that a proper and thorough examination of the mouth is the first thing necessary to be done in order that you may work intelligently. The question is sometimes asked: "Do you charge just for an examination?" Why, of course you do. Does a patient go to a physician and have an examination made without expecting to be charged for it? Then why should they expect to have an examination made at the hands of a dentist, without being charged for it? In cases where there is considerable mal-occlusion due to the loss of one or more teeth, a proper diagnosis can only be made by taking impressions of the mouth and making models so that the case may be studied from every aspect. Too frequently the dentist fails to note the loss of contact points between adjoining teeth or various stages of pyorrhea which frequently obtains in the mouths of patients who are wholly ignorant of its presence. A proper

diagnosis should include the discovery of every caries spot in the mouth, of every dead tooth where proper root canal work has not been done, of every cause for pus, which may be present in the mouth or concealed below the gingival margins, whether from necrotic tooth substance or pyorrhea conditions, or anything else. It is the duty of the dentist to make known to the patient all the pathological conditions which are present, and point out the importance of having them corrected.

In regard to the question of fillings. How many fillings do you see from the hands of other dentists which are properly finished? What proportion, let me ask, of the amalgam fillings which come under your hands have been properly polished? Every man who practises dentistry knows that a highly polished surface furnishes an environment which is less liable to the recurrence of caries and yet I will venture the assertion that not five per cent. of the men who are inserting amalgam fillings insist upon the patient returning at a later date to have the amalgam fillings properly polished. Knowing the advantage of a polished over an unpolished filling, would your conscience permit you to leave an unpolished filling in the mouth?

If it were only a question of polishing the fillings, the matter would not be quite so bad, but unfortunately most of the amalgam fillings which are placed in the mouths to-day, are little if any better, than those which were made many years ago. There is little or no attempt to secure a properly protected inter-proximal space or a properly contoured occlusal surface. This question was most forcibly brought to your attention some while ago by Dr. J. Lowe Young, and it is hoped that the lesson which was contained in his essay will be spread broadcast throughout the dental world and given proper heed.

Root canal work is probably as difficult as anything we have to do, if we do it properly; and still it is a subject which is probably given as little attention in proportion to its importance, as any other branch of our work.

Coming to the question of crowns, I am going to pass around for your inspection some crowns which have been ex-

tracted from the mouths of patients whose work has been done by well-known men in the profession, and I assure you, gentlemen, that it is not a matter for mirth or merriment when we observe how poorly these crowns fit the necks of the teeth; for I am not at all sure that the crowns which you and I are putting in the mouths to-day, with our most careful manipulation, are so perfect that we would be proud to exhibit them as samples of our work if they could be shown on extracted teeth. A fair proof of this supposition lies in the fact that when we do find an extracted tooth bearing a crown which we have made and which is a fairly good fit, we show it to our neighbor with a little feeling of pride and satisfaction as being something out of the ordinary, and even those crowns, we are willing to admit, could be improved upon.

I made an assertion some years ago, and I repeat it now, that where conditions will admit of it, the most sanitary crown is that where all of the margins lie exposed above the gingivae. This, of course, would only be possible in cases where the patient had ready access to all of the surfaces in order that they may be kept properly cleansed.

Let us now take up the question of bridge-work. I am handing you first of all some vulcanite saddles with gold clasps which were made twenty years or more ago and which you will readily recognize, are fair samples of what we meet with from time to time in the mouths of patients. Unfortunately, many of the restorations which are made to-day are not only no better, but not different from these of twenty years ago. I shall pass around also one or two samples of fixed bridge-work which are fair examples of many of the bridges which are being made to-day, and I am almost tempted to suggest that the patient's teeth are preserved to him, not because, but in spite of such work. Why will men continue to put work of this kind in the mouths of patients who want their best services, when they know in their own hearts that that is not the best service which the patient could have? Any bridge which is difficult to cleanse is not a proper bridge to place in the mouth of any patient. I shall pass around now for your inspection a bridge which was made some

years ago by a friend of mine as a show-piece, and which was exhibited both to patients and fellow dentists with all the pride of an artist exhibiting his painting; and I claim for this bridge that it is a far better piece of work than the average of those placed in the mouth to-day. I do not wish to be understood as condemning all fixed bridges, but I do maintain that when a fixed bridge is made, it should be given proper consideration from a sanitary as well as a mechanical standpoint.

Where the conditions will permit us to do so, restorations should be made with a removable piece, and these, too, should be given proper consideration as to cleanliness. I shall pass around first of all a removable bridge which I placed in the mouth of a patient some twenty years ago and which was removed within the past few weeks, and which tells its own story. This is one of a number of bridges of this type which I made about that time, in my effort to provide something better for my patients than the stereotyped and generally accepted forms of bridge-work.

The teeth which carried the abutments of this bridge are now doing service as abutments for a removable bridge of a different type, a copy of which I shall hand you in a few minutes; but before leaving this particular style of bridge, I wish to call your attention to the improvements in technique which are possible with this same bridge, and I shall now pass around for your inspection a copy of a bridge made on the same principle, so that you may compare it with the original. You will observe that the removable portion of the bridge is given a broader surface-bearing upon the gums, thereby lessening the strain upon the abutments; that greater care has been observed in the forming of the occlusal surfaces; that the gold crown has been done away with as an abutment for the cuspid, and that the crown for the molar is of a more modern type, to say nothing of the better technique in assembling the bridge. Many of these bridges are still doing good service in the mouth and the principle is one which may still be used to good advantage, but it should never be followed in any case where there is the slightest tendency to pyorrhea in the abutment teeth, as the bar which joins the two abutments makes

it impossible to observe absolutely sanitary conditions at the gingival margins of the abutments.

What is true of this bar is also true of any attachment for a removable bridge which is fixed to the abutments and protrudes onto the gum at the gingival border.

I shall now pass for your inspection two bridges which are made for the same case, but which have different kinds of abutments, although in both of these cases you will observe that when the bridge is removed it is possible to cleanse absolutely every surface of the abutment.

I have here for your inspection some other cases of removable bridge-work which may be of interest to you, one of them a lower bridge, with split bar attachment, and another is a model of a bridge which one of my patients has been wearing for some time. I am passing with this model a technique model of the case which was made for the purpose of showing how the abutments should be attached to the removable portion.

It was my original intention when invited to come before you, to read a paper on the technique of removable bridgework, but as I gave the matter further thought, these facts which I have presented for your consideration seemed to be of such vital importance and there is such a crying need for an awakening among the members of our profession to better efforts that I could not refrain from bringing you this message.

SOME AFFECTIONS OF DENTAL ORIGIN, REMOTE FROM THE MOUTH[1]

By Harry B. Shuman, D.M.D.

I wish to outline for you in a very cursory manner the development to date of the present belief regarding certain joint affections formerly called rheumatism. In so doing I hope to show you how our specialty, the mouth and teeth, has found a place of uplifted importance in medical opinion.

The old concept of rheumatism was an acute disease of unknown origin, characterized by fever, sweats, and inflammatory involvement of serous membranes, particularly those of the joints and heart, which might produce permanent structural change in the tissues affected.

Occasionally this acute phase was observed to pass into a subacute or chronic stage characterized by the absence of the general symptoms and the progressive involvement of one or two joints. That this transition did occur was not to be doubted and it furnished reason for including under the term "chronic rheumatism" not only those cases of chronic arthritis preceded by an attack of acute inflammatory rheumatism, but also nearly all cases of chronic joint diseases not definitely due to tuberculosis or trauma.

This all embracing term "rheumatism" was generally adhered to, although it was well recognized that many of the cases of chronic rheumatism had no history of antecedent disease and that they presented marked divergencies in pathological anatomy and in clinical course; and its wide acceptance was conditional on the assumption that the acute stage often passed unremarked, owing to its mildness or brevity, and that rheumatism was protean in its nature, producing, according to soil, or diathesis, the most varied lesions.

That much loose terminology persisted for so long need not lead us to reproach our elders with lack of acute observation or deductions, since the absence in former times of our newer methods of case study, of modern means of diagnosis and of the gradually accumulated stock of knowledge on

[1] Read before the Harvard Odontological Society, Jan. 15, 1914.

which we draw with thoughtless freedom, made exact classification impossible.

Whatever differentiation might have been attempted must necessarily have been largely speculative in nature, and must have proved as unproductive as speculation has ever been in medicine.

Advance, then, in our knowledge of joint affections was slow, and often, indeed, only secondary to study in other fields. For example, Charcot, the French neurologist, noted that monarticular affections of a constant nature occurred not uncommonly in certain diseases of the spinal cord, particularly tabes and syringomyelia. As it became generally recognized that these were trophic in nature and truly dependent on lesions of the cord and peripheral nerves, they ceased to be called chronic rheumatism and were styled "Charcot's joints."

However, as might be anticipated, the affections that were differentiated in such incidental fashion were very few, and not until the searching methods of the new science of bacteriology were applied directly to the problem did light appear. The radical rearrangement of views regarding joint cases that rapidly follows may be illustrated by the results of Nisser's work on the gonococcus.

The frequent association of gonorrhea and inflammation of certain of the larger articulations was common knowledge, but the nature of the association was so little understood that "gonorrheal rheumatism" was the term universally employed in describing these cases. It was only after Nisser showed in 1877-80 that the gonococcus was the infective agent in gonorrhea, and furthermore demonstrated the organism in the joints as well as in the urethral discharge, that the metastatic character of these cases was realized and that the term arthritis succeeded rheumatism in common nomenclature.

Nisser was not alone in this work. Pasteur and Koch had just previously demonstrated to the world the part played by bacterial infection in the causation of human disease. Their methods of investigation were quickly taken up everywhere, and cases were studied afresh by men imbued with the new ideas. Autopsy material was subjected to careful bacterio-

logical study, synovial cavities were asperated during life, and the fluid examined in smear and culture.

By these studies it quickly became certain that many cases of joint disease were due to the lodgment of bacterial organisms which had entered the blood stream from sites more or less remote, such as tonsils or genito-urinary tract, or had gained entrance by some unknown atrium constituting the cases of cryptogenetic infection; and these cases were thereafter known as pneumococcic, streptococcic, typhoid, influenza, etc., and their occurrence as complications or sequelae of tonsilitis, bronchitis and urethritis was fully recognized.

To all these very numerous cases, a new term came to be applied, viz., infectious arthritis, and they, too, ceased to be called rheumatism.

There were, however, some cases, undoubtedly infectious in origin, in which there was complete failure to recover the organisms in culture, or to demonstrate them microscopically, and it was assumed that in these cases there was not actual lodgment of the infecting bacterium in the joints, but that its toxins, generated elsewhere and circulating in the body fluids, and exhibiting a selective chemical affinity for joint tissues, had set up a chemical inflammation which would persist so long as the toxins continued to be absorbed into the circulation.

To describe these cases, the name "toxic arthritis" is often used; but since some doubt may always exist as to whether a given case is purely toxic in origin, it is well to regard infectious arthritis as including not only those cases in which the bacteria effect actual lodgment in the joint structure, but also those cases in which the joint is injured by toxins absorbed into the circulation from a bacterial focus, perhaps both minute and remote.

It may be added that acute inflammatory rheumatism itself, is not generally acknowledged to be a disease entity, but an acute infection with certain cocci. This conclusion is supported by analogy, and by sound bacterial investigation in which the postulates of Koch have been found to hold good—viz. (1) the organism must be universally found in lesion:

(2) it must be capable of being cultivated in pure culture; (3) the culture when injected into susceptible animals must reproduce the original disease; (4) it must be recoverable from the infected animal. This disease is therefore now considered an acute infectious arthritis.

Thus we have seen the movement toward a rational classification of joint diseases develop naturally along lines fixed by the trend of discoveries, the classification coming to depend on etiology. Charot's joints, gonorrheal arthritis and the numerous infective joints were in turn differentiated from rheumatism by the discovery of their respective causes; they received names indicative of those causes, and our conception of their pathology is based entirely on their causation.

This system, although owing its origin to the sequence of discovery, proved so serviceable that it came into general use. As a result we have forms of arthritis in addition to those already mentioned, viz., the senile, the arterio-sclerotic, the glandular, dependent on disturbances of secretion in the ductless glands; the trophic, as that accompanying diseases of unknown etiology like psoriasis, and the metabolic.

However useful this etiologic basis of classification has proved, nevertheless it does not lend itself to indefinite extension because of existing limitations in our knowledge of etiology. The occurrence of such terms as "metabolic" is a confession of such limitations.

That we employ terms which include such diverse and complex chemical processes indicates that we can do no more than suggest loosely in which department of pathology the disturbance lies, and that we are still unable to state with any degree of precision the process or the substance at the root of the mischief.

Hence it follows that, pending further additions to our knowledge regarding the causes of arthritis, the requirements of teaching of collective investigation and of medical intercourse led men to seek bases of classification other than causative in those cases in which the cause is known vaguely, or not at all; and a number of investigators, working independently, have had to resort to pathological anatomy to furnish a working basis for groupings.

Working with the Röentgen ray and with material obtained from operations and autopsies, these investigators have been able to separate the rather numerous cases in which no definite etiology is ascertainable into two main groups that are clearly differentiated by symptoms, clinical course and the anatomical changes constantly met. One of these, characterized by proliferation and subsequent metaplasia along the edges of articular cartilages, is called "hypertrophic arthritis," or osteo-arthritis. It is usually chronic and limited to the spine or a few of the larger joints. The other form is somewhat more inflammatory, symmetrical joints often being attacked progressively. The cartilages and epiphyses, instead of showing proliferation, undergo rarefaction, atrophy and even absorption. This varity is descriptively named arthritis deformans.

The foregoing will serve as a brief survey of the main groups of joint diseases, and the general nature of each; and we may now turn to the relation of these affections to our practice.

Of the total number of cases met, by far the greatest number will be cases of infectious arthritis, and this group already so large, is being rapidly augmented, because many cases formerly supposed to be atrophic, since their bacterial origin was not discovered, are now definitely known to owe their origin to an infective focus. It is in this large and growing class of diseases that the dentist is interested, since the focus so often lies within the mouth.

It will be recalled that infectious arthritis was said to be due either to the lodgment of bacteria or to the absorption of toxins from a bacterial focus situated anywhere in the body.

Since cure of the arthritis is altogether dependent on the cure of the primary focus, the discovery of the focus is of first importance.

This focus may be obvious, as in urethritis, pneumonia, influenza, or typhoid; on the other hand, it may be minute and discoverable only with the utmost difficulty. When the focus is a pyorrhea it may be at once evident on inspection; when it is a minute root abscess giving rise to no symptoms

it may be discoverable only after the most painstaking search.

The importance of this class of cases to the dental practitioner may be grasped when it is known that the teeth are second only to the tonsils in the frequency with which they harbor foci, and that more than half of arthritis cases owe their origin to lesions situated in the mouth, the province of the dentist.

Bibliography—A review of the literature on rheumatism and arthritis.

MECHANICAL CONSTRUCTION OF CROWNS AND BRIDGES[1]

BY LESTER F. BRYANT, D.D.S., CHICAGO, ILL.

Your committee asked me to talk to you about my personal methods of constructing inlays, crowns and small bridges. I shall not have much to say about inlays, except in their relation to bridge work, but shall try to confine my remarks to the mechanical details involved in perfectly fitted, perfectly contoured and perfectly adjusted crowns and bridges.

It is a sad commentary on our profession, but I believe that the crown and bridge work done by the profession at large is inferior to any other mechanical operation it has to perform, unless it be root fillings.

At least three-fourths of the crowns and bridges that I see in Chicago are failures, from a mechanical aspect, before they are set.

I shall not attempt to describe these irritated and unsanitary conditions, as I feel certain that you men find these same conditions existing in the mouths of the new patients that come to you.

So, then, let us consider for a moment what the essential mechanical details are, that constitute a non-irritating, prophylactic, serviceable restoration of a tooth crown. First, we must have perfect adaptation to the root. This necessitates a form of root preparation that will afford a positive seat, and sufficient retention for the crown when set.

Second, contour.—To obtain the proper contour we must strive to reproduce as nearly as possible the natural crown that has been lost. A close study of the remaining teeth should show the mechanical elements such as planes, surfaces and cusps, and what the function of each may be. If, however, the remaining teeth are in such a poor state of preservation that this is impossible (and it is a lamentable fact that this is often the case) we must use our own judgment as to

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[1] Read before the First District Dental Society, Section on Crown and Bridge Work, Porcelain and Gold Inlays, New York City, January 21, 1914.

the proper form. The age of the patient is one of the best guides to go by. A sixteen-year-old tooth would not be efficient in the jaw of an individual forty years old, or vice versa.

The contour, then, must be such as to afford good contact points, and yet preserve the normal interproximal spaces. The buccal and lingual surfaces must be formed so as to protect the gingival border from the crowding of food. The articulation must be so adjusted that the occluding planes of each cusp will get no more than its share of work, and the stress must be directed along the long axis of the tooth.

With these preliminary remarks, I will try to describe in detail my method of combining the links in the chain of details to make a crown.

I think it is generally conceded that since the advent of the cast inlay, the posterior teeth must be quite badly broken down or weakened by previous fillings before crowning is necessary.

So, in most cases, I cut what is left of the root, down below the gum, using a small cross-cut fissure bur to excise the tooth, finishing down to the gum with carborundum stones. The remaining enamel is then removed and the root planed smooth with scalers. The pulp chamber is then squared up to form a flat seat; in other words, cut out so as to have definite angles and be about one millimeter deep.

When this is done the root is shortened, so that the cap will fit under the gum. A safe sided root facer with the center pin cut off to be slightly shorter than the depth of the cavity in the root, is used for this purpose. In cases where, on removing an ill-fitting crown or a large filling that has failed, carious conditions are exposed extending under the gums, this form of root preparation and subsequent method of fitting the cap is especially applicable. The cap is made of thirty-six gauge platinum; the method of fitting is as follows: In the event that the root is broken down, and the gum has filled the cavity, the gum must be packed away with gutta percha for a day or two, in order to get a well-defined impression. The impression is taken with a cone of base plate gutta percha Then the impression is set down in plaster of Paris, and a die

and counter-die of Mellote's Metal is poured. It is an advantage to get a sharp die, and the method of obtaining it is as follows: Tepid water and salt or sulphate of potassium should be used to mix the plaster, in order to make the plaster set as quickly as possible; the reason for this being that the moisture is all taken up by the quick chemical action. Put the plaster in a rubber ring and press the impression deep down in the plaster, then trim the plaster smooth around the edges. Next, remove the rubber ring and carbonize the mold with camphor gum smoke, replace rubber ring part way over the mold and pour with clean Mellote's Metal, as cold as it will pour, jarring the mold until the metal is set. Paint this die with a mixture of whiting and alcohol, and pour counter-die.

This whole procedure must be done at one time, in order to make a sharp die, which is only obtainable by pouring the metal over the plaster while the chemical process is going on in the plaster. The reason for using the carbon is that all white metals cast smoother on a carbonized surface. To clean Mellote's Metal, stir in a small quantity of resin. Pour the metal into small patties. The dross will remain in the ladle, and can be wiped out with a cloth.

On having made the die and the counter-die, it will be found a very simple matter to burnish and swedge the cap to approximately fit the root. It is not essential that the metal be burnished over the periphery at this time, only care must be taken not to trim too close to periphery. The next step is to fit the cap directly over the root. Place the cap on the root, and press to its seat as well as possible with large serrated amalgam instruments, finishing with rapid action engine mallets. This will show the exact outline of the circumference of the root. At this time the excess material should be carefully trimmed off, leaving one-half to one millimeter for a band. Replace the cap on the root and punch holes for the posts that have previously been fitted to the canals. Wax the posts to the cap with sticky wax, then solder them to the cap with as small an amount of platinum solder as possible. It is not necessary to invest, just press the cap into asbestos; it holds them in perfect relation and saves time of investing. The cap is

then replaced on the root, and reseated with the mallet, commencing to spin the surplus over peripheral edge of the root. Then with these four serrated instruments, which I call "tuckers," tuck the surplus under the gum to form a band. Next disk the edges of the band down to the amount of lap desired; and a perfectly fitted cap is produced.

To insure against distortion of this delicate cap during construction of the crown, coat the posts lightly with wax and the cap with vaseline. Then form a root of cement into the cap; the cap with the root in place may then be put into the impression. Vaseline the root well before pouring the model, so that it can be removed from model while making crown.

Wherever I have room to insure sufficient thickness of material, I like to make all crowns of porcelain, using the S. S. White high fusing 2560°. Molars are carved without a facing, but facings are used on all the eight anterior teeth to facilitate in getting the proper colors.

In the class of cases where no facing is used, we must protect the cap so that the shrinkage of the porcelain will not distort it. As the porcelain shrinks about one-sixth, it will be seen that unless the posts that extend through the cap were braced, the shrinkage would draw them together, causing a corresponding divergence in the roots. To make this brace I use four pieces of twenty gauge platinum wire; place them on the anvil to form a square, lapping one over the other the same as a screen is woven. Then with a heavy hammer flatten them out; then solder the points with platinum solder.

We now have a small grating that is only twenty gauge in thickness, but very strong; this is adjusted to the posts so that the friction of shrinkage will be controlled. Thick shellac is smeared on the edges of the cap to keep the shrinkage from drawing up the edges.

In cases when a facing is used, if the exact color cannot be procured, and this is not infrequent, select a facing that is lighter rather than too deep; then grind out the parts of the facing where you want to add color, and use porcelain that fuses at 2300° for this purpose. When the crown is just about right, and only needs a little added here and there, porcelain fusing at 2200° should be used.

Where the bite is too short for all-porcelain, I make gold-backed crowns. These crowns are cast, the facing being withdrawn from the wax carving, and graphite points inserted in the pinholes. No special attempt is made to get the gold to cast down over the labial or buccal surfaces of the cap, where the cervical position of the facing rests. In fact, if there is not sufficient bulk of wax to insure accurate casting, the wax had better be cut away at this point, so that the gold will not cast over the cap at the cervical. On fitting the facing there will be a space between the facing and the cap; this space may be filled with porcelain when the rest of the crown is finished.

To restore the cervical border with porcelain, coat the part of the cap you want covered with porcelain with flexible collodion; this fills up all undercuts and rough places in the cap, leaving a glass-like surface. Vaseline this surface, using as little vaseline as possible; clean the facing with chloroform to cut off all grease, and then with facing in place, thin porcelain may be jarred down into the crevices. When the porcelain is very nearly dry the facing may be removed, and the thin film of porcelain will adhere to it. After baking it will go right to place, producing a most perfect cervical border.

Shell Crowns.

In my practice I find the indications for shell crowns comparatively few, for, where enough tooth structure is left for a small crown, an inlay in most cases will do better work. But where a shell is indicated, I want a crown that is not only adapted to the cone-shaped root at the gingival, but to the entire length from cervical to top. Before the advent of casting this was a difficult crown to make, because it was hard to produce the proper contour, but now it is very simple.

A platinum band is fitted in the ordinary way, festooned carefully, so that it will go under the gum at all points without impinging on the cervical attachment. The band is then cut level with the top of the root, and a platinum floor soldered to it. The contour and occlusal surface can then be restored with wax and cast. This gives a solid form of construction that goes to a positive seat and a contour that can only be equaled by the seamless method.

Broken Down Roots.

In this class of cases, where there has been extensive destruction of the root, either from caries or accidents, and a shell crown is indicated, the first procedure is to pack the gum away with gutta percha, so that the cavity margins are clearly exposed. Then a gold inlay should be made to restore the continuity of the root.

Another class of case, where the gold inlay and shell crown go nicely together, is where there has been considerable recession of the soft tissues exposing the two buccal roots of a molar, for instance. A gold inlay inserted in the buccal surfaces of these roots obviates the almost impossible task of festooning a band to the outline of the gums on these exposed roots.

Bridges.

I am not here to give you a long paper on the indications for and against fixed bridges; but to give you certain mechanical details that go to make up a method of bridge construction that appeals to me. These may not fit in with your methods, or you may not believe in them at all. In that event we may be able to bring out facts in the discussion that will be to our mutual benefit. To give you a general idea of my methods, I will summarize as follows:

First, all bridges are made of gold, either with or without facings; second, the anchorages are one of the classes of gold crowns I have described, or gold inlays.

In lower posterior cases, where it is essential that the occlusal surfaces be porcelain, diatoric or Goslee teeth are used. If not too extensive they are cast in one piece; otherwise they are made in sections and united with solder.

All bridges are of fixed type, for the reason that all the strain to which the roots may be subjected has been taken into consideration in the construction. Then again, when the attachment of the roots has been weakened by pyorrheal conditions, the fixed bridges afford the best possible splint. In this condition the roots should be either drawn to the mesial or pushed to the distal, to take up what play there may be in

the socket. The attachment of these roots becomes much stronger if treated in this manner.

If properly constructed along sanitary lines, the fixed bridge is a far better prophylactic risk than the removable type.

All bridges are so constructed that in subsequent prophylactic treatments they may receive the same care the remaining natural teeth receive.

All surfaces must be convex. There must be no sharp angles, and the case must be highly finished. An irridio platinum bar must be an integral part of all bridges to control shrinkage of the casting.

Now I think that with these few general thoughts we may take up the details. We will assume that the case is on the articulator ready to construct, and is an upper, from cuspid to second molar; the same as the specimen you have seen. The selected facings are ground to place, and the intervening teeth between abutments are ground on the proximal surfaces from the contact point to the cervical, giving the tooth an exaggerated bell crown appearance. The cervical end should be as small as possible and still look well.

The model is trimmed at this point so that the dummies will press firmly on the soft tissues, but not hard enough to irritate. As the gold must cover the entire lingual surface of the facing, it is often necessary to hollow out the cervical portion of the facing to make room for the gold. This fact should be borne in mind when selecting the facings—select facings having pins as near the occlusal surface as possible. It is sometimes necessary to select longer facings than needed, and grind them so that the pins will come to the proper point. Often it is necessary to bake in porcelain here and there to get the facing to set just right. It may seem that this amount of detail is unnecessary on such a small spot as the cervical end of a dummy. But if we are to make sanitary bridges, the aforesaid detail is essential. When the grinding is finished the facings are waxed to place, then a small quantity of plaster is poured on the buccal surface of the model and facings to make a front piece.

This is made to facilitate the adjustment of the irridio-platinum shrinkage bar and the waxing of the bridge.

The facings may now be beveled on the cutting edge and proximal surfaces, and set in the front piece. If the pins have been bent down the bevel on the cutting edge must be at the same angle as the pins. The front piece, with facings in place, is put back on the model, and the shrinkage bar adjusted. This bar should be made of fourteen gauge wire and bent so as not to conflict with the pins of the facings, and must be in contact with either the posts or bands of the abutments, or inlays if they are used. It may then be waxed to place and soldered to the abutments with platinum solder.

Waxing Bridges.

The model and front piece are coated with thin shellac and then oiled with olive oil. The facings are cleaned and oiled and set in the front piece. The front piece is set on the model and the casting wax may be melted in. When sufficient wax is applied and is cooled enough to keep from crumbling the articulator may be closed to get the occlusion. If the case requires much wax, time may be saved by dropping the wax in with a medicine dropper. The front piece is now removed and the wax carved and contoured for casting. When done, the facings are removed and graphite points set in the pin-holes. The case is now ready for the sprues.

Adjustment of Sprues.

The sprue wire is set in the center of the case and placed on the crucible former, on which a wax ridge has been previously made, so that the extra sprues may be attached. These extra sprues must run from the wax ridge to the bridge. They are made of wax, and the best way to make them is to fill an old self-filling water syringe with paraffin and wax. Then warm this slowly, and you may make wax by the yard.

When the case is all sprued ready for investment, it should be washed with liquid soap and thoroughly rinsed in cold water; this removes all grease and small particles of wax, facilitating the flow of the investment.

Heating.

Care should be taken not to heat the case too hot in burning out the wax, as an investment expands slightly to a certain degree of heat; after that the expansion is terrific. All cases are cast with mold warm. In cases where there is more than one sprue, enough gold must be used so that the surplus will cover all sprue holes where the case is cast, because, if there is not enough gold to cover, air will be forced into the mold and cause failure.

The ratio of wax to gold is approximately one to twenty-four by weight with the average wax.

The finishing of a bridge is a very essential detail, and utmost care should be used to remove all scratches and obtain a high polish. All facings that have been ground on the buccal or labial surfaces must be polished or reglazed.

Repair.

In the event of a broken facing the repair is made in the following manner:

The pins are removed and the holes redrilled to clear out cement, using a No. 19 gauge twist drill. Then put two new pins in the holes in the backing, and take an impression with Detroit modeling compound; the pins will come out with impression; set this down in plaster, vaseline the pins, and fill with cement. We now have a cement model with the pins in place. Remove the pins and select a facing, care being taken to get a facing with the pins the same distance apart as the holes in the model. Grind the facing to roughly fit the model, then coat the model with collodion and proceed with porcelain as has been described. This process may require several applications of porcelain to get a perfect reproduction of the fractured facing.

Inlay Anchorages.

I have left inlays to the last, but that does not mean that I consider them last in importance as bridge anchors. Wherever indicated, they make a most efficient anchorage, and because of the economy of tooth structure are superior to

crowns. Wherever possible in these cases the pulp should not be devitalized; this is especially advantageous in anterior cases. The cavities in posterior teeth should be extended well from buccal to lingual and occlusal to cervical, so that there will be good clearance beyond the attachment of the bridge teeth. If the cavity be a mesio-occlusal, a good deep pit must be cut in the disto-occlusal portion of the cavity for retention; small pits should also be cut in the cervical border at the buccal and lingual angles. The cavity should be about the same depth at all points; consequently the filling will be the same thickness at all points. This point should be striven for as a filling of the same thickness is less apt to warp. It should be remembered that all cast contact cases should be allowed to cool slowly to prevent warpage.

These same rules apply to the cavity preparation of anterior teeth, with the exception that the extension labially should not be so great, but the extension lingually should be to the center of the tooth. The filling may be very thin as the torsional resistance to be overcome is not nearly so great as in posterior teeth.

It is good practice, where inlay anchorages are used, to try the case in the mouth after the shrinkage bar has been soldered, to be sure that the alignment of the inlay cavities is correct.

In conclusion, I want to say that this paper is not offered as a complete dissertation on the principles of crown and bridge work, but only to emphasize some details that the writer considers essential.

REPORTS OF SOCIETY MEETINGS
FIRST DISTRICT DENTAL SOCIETY, STATE OF NEW YORK

December 1, 1913

A regular meeting of the First District Dental Society of the State of New York was held on Monday evening, December 1, 1913, at the Academy of Medicine, 17 West Forty-third Street, New York City.

The President, Dr. Henry W. Gillett, occupied the chair, and called the meeting to order.

The paper of the evening was read by Dr. John R. Callahan, of Cincinnati, and was entitled "Rosin Solution for the Sealing of the Dentinal Tubuli, and as an Adjuvant in the Filling of Root Canals."[1] The paper was illustrated with lantern slides.

Discussion on Dr. Callahan's Paper

Dr. M. L. Rhein—Dr. Callahan's work is always of such a character that we feel we can rely upon what he says to us. He ranks among those of our profession who are known by their works, and it is not merely a matter of theorizing that he brings to us. It has been my good fortune for a great many years to be in close enough communion with Dr. Callahan to feel a strong bond of sympathy with him, and to feel that we hold a view that has a great deal in common on this subject; so whatever little points I may bring up in the discussion, neither Dr. Callahan nor myself feel that they are in opposition, but more in elaboration, perhaps, of the subject.

I have watched Dr. Callahan's work in regard to rosin with a great deal of interest, and have been waiting to get a more final result. What he has told us about its application on the dentin of teeth with living pulps, ought to be a matter of very great value. The pathologic conditions that affect the pulps of every tooth that is subject to any sort of irritation are perfectly familiar to every one who has given much

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[1] See Dr. Callahan's paper in full at p. 53, this number of THE JOURNAL.

laboratory attention to this matter. It does not require a filling too near the pulp or a very large inlay to produce a potent pathologic effect upon a tooth with a live pulp. There is very little doubt, however, that that effect must be materially increased as we get nearer the pulp, and consequently the use of this substance, flowed over the dentin in all cavities before filling ought to be of very substantial value in the field of operative dentistry.

He has also illustrated the use of rosin as an adjuvant in sealing the root canal with what should be a homogeneous and solid mass of gutta-percha; he has distinctly brought to our attention the fact that the main object of the solution of rosin is to seal the tubuli which are too microscopic to admit of the gutta-percha itself. In this respect, in the past, I have relied on filling and sealing these tubuli with the oil of eucalyptus, having prior to that positively determined that every particle of organic material in the canal has been removed. Then the entire periphery of the canal is in an absolutely aseptic condition, absolutely free from micro-organisms of any kind, and in a condition where they cannot be infected. This is one of the little differences that I have with the essayist, and to which point I expect to lead him; because if I understood him correctly, he questions the possibility of the absolute sterilization of the infected dentin.

When he made that statement, I knew that he meant in a certain class of cases, because I was thoroughly conversant with the fact that in the majority of the cases he handles, he realizes that he gets absolute sterilization of the entire canal. But I want to call attention to the fact that there is no valid excuse for not having absolute sterilization of every canal, as regards that portion of the inner periphery of the canal. In fact, I do not feel that we have a right to seal a root filling in a root unless that condition has been attained. If we are going to leave any particle—I do not care what part of that root it may be—in a condition where it is subject to infection, we are leaving in the mouth of the individual an agent that is liable to produce a toxemia that can be of the most virulent type; not in connection with the nature of the micro-organism it may possess, but as regards the result it may have.

Right here, while we are on this subject, before proceeding to say how this condition can be attained, I want to bring up another little point that I do not think the essayist made quite clear, and that was his allusion to the question of (as he put it) the dormant abscess, a form of what we know as a blind abscess, or a pulp that has been treated supposedly correctly, given no trouble, and then at some later date proceeding to give trouble. As I recollect his paper, he speaks of this low type of infection suddenly developing into a virulent form. It is right at this point that I want to bring out the bacteriologic factor—the danger to the individual during the time that that condition was present in a non-virulent form, when these bacteria were of the lowest possible grade, most likely the streptococcus *viridans*, which is the most dangerous to the individual in whose mouth it is.

In other words, at the time or during the period when an abscess is absolutely not perceptible to the sensation of the individual, it is far more dangerous than when we find a virulent active abscess with a sinus that has opened into the oral cavity. It has been recently proven that the streptococci and the pneumococci can and do change their potential characters, and assume different forms of the same grade of bacteria; that is, that the pneumococci, for instance, can be changed into any one of the different types of streptococci.

Now when we are studying the streptococcus *viridans* we have this non-virulent type, nearly always present in a blind abscess, which is almost imperceptible to the individual. Do you suppose for a moment that the small amount of infected material that is being manufactured daily, there, though confined by the pyogenic membrane, is not being forced into the circulation? By no means. Although very little of it goes into the circulation, it has been clinically demonstrated that the toxines produced from this non-virulent type goes directly to the valve of the heart, and produces the most disastrous valvular disease of the heart that the individual is subject to; and it is for this reason that it is far more dangerous to the individual than when we get an acute abscess that causes pain and discharges the pus freely into the mouth.

When I say that it is feasible to produce a complete sterility of the canal, I mean that when you have by means of the Röentgengram demonstrated that you have reached the end of all the canals, when you have placed wires in the canals and found that you have reached the ends and you have removed all of the organic material, then if you resort to ionism —the forcing of electric ions through that dentin, as we were shown many years ago when cataphoresis was first introduced to the profession, we are bound to obtain an absolute sterility of the dentin, and that condition should obtain before the root filling is inserted. It is very easy to demonstrate this sterility, as I have frequently done. If you remove what you consider all of the organic material of a root canal, and then proceed to wash out that canal with an aqueous solution of hydrogen dioxide, you will get continual effervescence from that solution, indicating a lack of absolute sterility. If after a time you cease to get it, if you will take a small broach and work it up and down you will start it up again in some little bay-like excavation; but if you ionize that root canal properly, it will be impossible to get any effervescence from that solution; your peroxide solution will be as inert in that canal as it is in the bottle from which you have removed it, and I claim that this is a demonstration of the ability to put that canal in a sterile condition.

While Dr. Callahan has shown us a great deal in the possibility of the enmeshing of the bacteria in this rosin solution, we should not rest on any such means. It is only a few minutes' work to thoroughly ionize a root canal in this way, and I feel if the canal is then washed out with a solution that I have for many years advocated, a sublimate solution of $^1/_{500}$, we will get at the mouths of the orifices of all the tubuli—a microscopic portion of sublimate, that is perhaps the only permanent germicide that is capable of being introduced into the canal.

These remarks are not contentions between the essayist and myself. The only point is that I feel like carrying the gospel of absolute aseptic root work a little further.

I thoroughly agree with his position on the paraffin ques-

tion, that we are not in a position to-day to take a decided position in regard to paraffin for root filling. The difficulties that result from other forms of root fillings, all the metallic forms, are shown up so plainly by means of the Röentgengram that they are not worth considering.

Now we come to consider one other point the essayist has made. He says a perfectly satisfactory root filling has not been proven. I do not agree with him there. I will admit that I have made many unsatisfactory root fillings of gutta percha, but since the introduction of the X-ray, whenever I have made one of these I have removed it, because I felt that it would be criminal on my part to allow the patient to go away with a root filling of this kind in a root canal; and I do not expect to find a root filling of this kind again leaving my hands—that is to say, permanently. I am surprised, on the examination of hundreds of root fillings that I have made in the past thirty years, to find how few of them were not absolutely ideal when observed in the Röentgengram, and by ideal I mean the fact that the end of the gutta percha has sealed the end of the apex of the root, or of each root—has formed a cap in the apical region over the end of that root; and that gutta percha is absolutely solid, as far as it has been used in the root canal; and that it forms a solid homogeneous mass.

Now this is a matter of technique, as the essayist has said, and it is a technique that is simple; but it requires patience and a little time and care to be sure that it is done efficiently. I am showing this in our pathological section, clinically and theoretically, how root canals can be always solidly filled to the very end. But I want to put up a protest against the common objection to gutta percha—that it contracts—that it shrinks away from the wall. That is a libel on gutta percha that is absolutely untrue, and I defy anyone to prove it. The bringing into a discussion of a solution of chloro-percha in a bottle and showing how it has shrunk away from the wall is a most absurd argument. The contraction is no contraction of the gutta percha; it is simply the evaporation of the chloroform, and yet this infantile argument—with due apologies to some of the gentlemen who have used it—has been frequently thrust before us.

Part of the technique of properly filling a root canal with gutta percha is to be sure that all of the chloroform has evaporated before the gutta percha is covered with the next layer of sealing matter that you are going to use.

I have taken up more time than I ought to, and I want to close by showing a few slides taken hurriedly at random to-day from my gutta percha root fillings that are correct. Some of these that I am going to show you do not fill all of the root canal. When you are going to put a crown on a tooth, you have to leave space for your pin, and I am going to show you a combination of different forms of gutta percha root fillings. In my section I am going to show some very interesting specimens of imperfect forms of gutta percha root fillings, but to-night I simply want to show you what I consider is the correct form of gutta percha root filling.

Description of Lantern Slides

Fig. 1. Shows correct root filling in two upper incisors. The adjoining incisor has an imperfect root filling with abscess at end of root.

Fig. 2. Incisor with correct root filling showing perfect encapsulation of end of root.

Fig. 3. Lower incisor porcelain crown with correct root filling and encapsulation of end of root.

Fig. 4. Incisor and canine with correct root filling and lateral incisor porcelain crown with correct root filling.

Fig. 5. First bicuspid porcelain crown with correct root filling and encapsulation.

Fig. 6. This is from a boy seven years of age, but during the orthodontia progress an abscess developed at the end of the lateral incisor, which, although the apex was not closed, made it necessary to seal the canal, although it was in this wide open condition. I want to demonstrate the absolute ability to make a filling of this kind with gutta percha, if sufficient care is taken. By means of the Röentgengram the exact dimensions of that canal are easily determined, by comparing the length of the wire used in the X-ray with the dimensions of the root. That is to say, if the focussing shows that the width of the orthodontia bands are the same width as found in the picture, it is reasonable to suppose that the length of the wire in there is the correct length of the canal, and from this deduction that root filling was made.

Fig. 7. Shows an upper molar root filling. This is, perhaps, as difficult a tooth to obtain correct results as any. Notice homogeneous nature of gutta percha in all these pictures. The second bicuspid has two canals,

and picture shows wires in position previous to filling. Before the final reading of such a Röentgengram it must be studied again and again in order to obtain a correct view. Frequently it is necessary to obtain different pictures from different angles before a correct reading can be attempted.

Fig. 8. Same as Fig. 7.

Fig. 9. Lower molar correct root filling with encapsulation.

Figs. 10 and 11. Same as Fig. 9.

Dr. R. Ottolengui—I do not think it necessary to tell what I think of Callahan, because he knows my opinion of him, and I believe he might prefer to hear what I think of this method. Without having had an opportunity to test it, I am encouraged by the slides that he has shown to believe that it is very possible that Dr. Callahan has introduced to us a very effective method of filling and sealing root canals.

But Dr. Callahan speaks of conical shaped root canals, and of filling with cones of gutta percha, pressing the cone into the canal, withdrawing it and pressing it in, again and again, farther and farther. If with this method it is necessary to have the canal conical in shape, then I fear the method will be least efficacious where we need it most. I do not find it easy to make root canals conical in shape. Anyone can fill a canal which is of medium size and conical in shape, But very large canals, in young teeth, and very small canals in old teeth, are not so easy.

The small canals, in middle and late life, are very fine indeed and have parallel sides. They are not conical. Yet gutta percha points are always made conical. I have seriously taken this matter up with the S. S. White Company recently, asking them to give us very fine gutta percha points, with parallel sides, and pointed at the end.

How are we to alter the shape of these fine canals, so as to make them readily filled? I had not used a drill of any sort in a root canal for over ten years, when about three years ago at a dental meeting I saw a man demonstrating the Kerr drills. He was drilling holes through a tooth brush handle. Such a demonstration indicates how dangerous rather than how useful, a forward, or end cutting drill, is in a root canal. However, investigation showed that a number of men, whose

Fig. 1

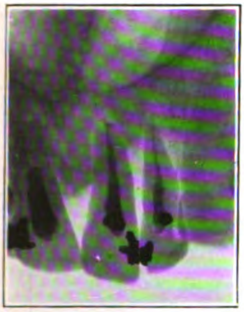


Fig. 2

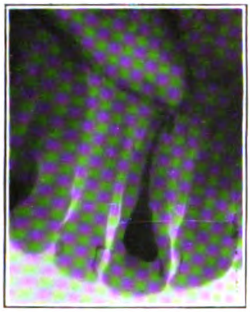


Fig. 3

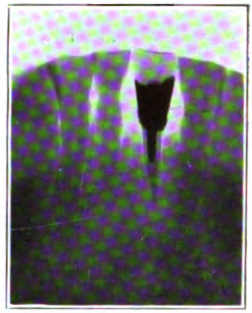


Fig. 4

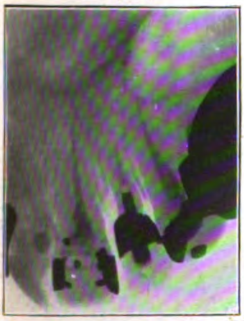


Fig. 5

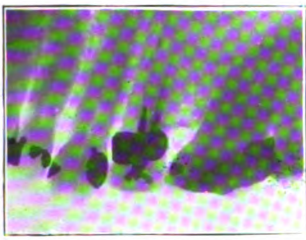


Fig. 6

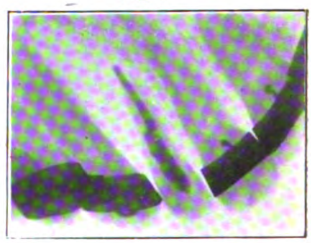


Fig. 7

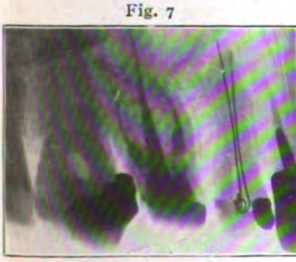


Fig. 8

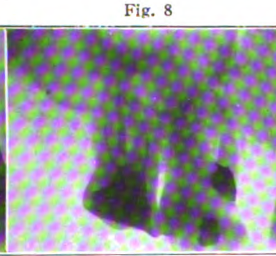


Fig. 9

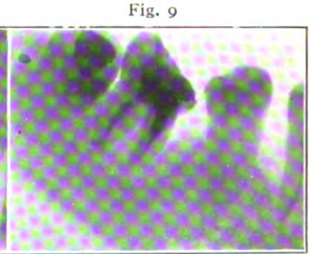


Fig. 10

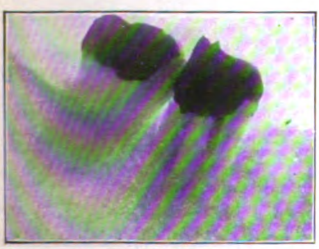
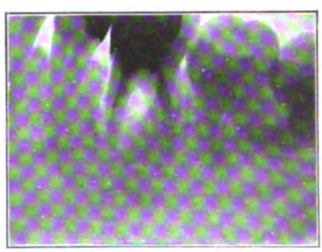


Fig. 11



See Dr. Rhein's discussion of Dr. Callahan's paper, page 115

Fig. 1

Fig. 2

Fig. 3

Fig. 4

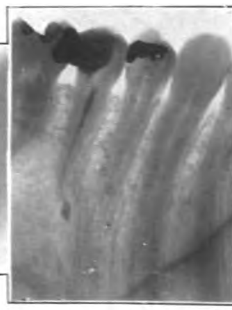
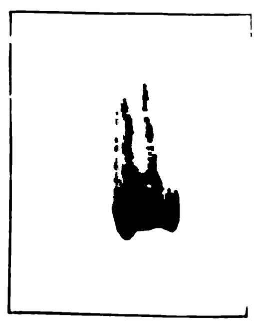


Fig. 5

Fig. 6

Fig. 7

Fig. 8



See Dr. Ottolengui's discussion of Dr. Callahan's paper, page 117

skill I recognize, were using Kerr drills, so I bought a few. I have used them cautiously since then, but not often.

Fig. 1 is a radiograph of an upper molar containing wires to determine whether I had reached the foramina of the three roots. In two I had done so successfully, using sodium and potassium. But in the anterior buccal, not getting up as far as I wished, I used a Kerr drill, and whilst I did not penetrate the side of the root, it will be clearly seen that I drilled a false pocket, the drill leaving the true canal at the curve. The serious part of this is, that after an occurrence of that character, there is no possible way to make any other canal instrument follow the true canal; it will always go into the false pocket.

Dr. Callahan said that with his resin preparation, even though he does not reach the end of a root, still the resin can be used because he has noted that it will penetrate anywhere, where there is nothing else. That may be true out of the mouth, but unfortunately in the mouth, the part beyond, usually, is filled with something else. Consequently, even with Callahan's resin method, I could not fill this particular molar root. The only safe method is to fill the three roots, and then amputate the buccal root at the point where a radiograph would show that the root filling terminated.

Fig. 2 shows another instance of very fine canals. I had cleaned all three root canals of a lower second molar, a radiograph showing wires to the end of all three. Fig. 2 shows the tooth after filling the canals. I fear that these very fine canal fillings do not show in the prints, as they do in the films. But though I used, as I thought, exceeding care, I discovered from the film, that my root fillings did not extend to the end of either root, and only a third way down the anterior lingual. Fig. 3 shows the same teeth after removal of the defective root fillings, and refilling, this time to the very extremities, as is clearly shown in the film, though perhaps not so clearly in the print. The first molar in these two illustrations is another story, that I may relate at some future time; suffice it to say that the radiographs indicate where an abscess once was, but is no more, the case having been cured.

Fig. 4 shows a root filling, where chloro-percha was used as an adjuvant, and you will observe that though the root is thoroughly filled, some of the chloro-percha has been forced beyond the apex. Dr. Rhein says that he does not mind that. Well, neither do I, because I take precautions to have my chloro-percha aseptic. Still, I wish that not quite so much had passed through. Fig. 5 pleases me better. Some of the root filling extends beyond the root end, and that is an advantage rather than otherwise. But I show these cases because with chloro-percha the radiograph will at least indicate to what extent our root filling protrudes, whereas I am wondering how we would ever know how much resin we may have forced beyond the apex. Again it has been abundantly shown that the tissues in this region are very tolerant of gutta percha (if aseptic, of course), but we have yet to learn what would occur with resin.

At the last National Association meeting, Dr. Callahan called on me to discuss Dr. Raper's paper on radiography, and in the course of my remarks I said that not only had the X-rays shown me how defective other men's root work was, but that since I had installed a machine in my own office I had learned the faults in my own technique, and that with the aid of the radiograph I now found it much more possible to fill root canals to the end. Some member in the vast audience cried out: "Tell us how you fill them to the very end." On a sudden impulse I replied: "I fill the end first!" This was met with prolonged laughter. But I did not mean it as a joke, but as the most serious statement. I always fill the end first. That means that in small canals I am afraid to use an entire cone, because the upper or larger diameter of the cone may prevent the smaller or pointed end from ever reaching the foramen, however well one may have cleaned out the canal. Sometimes after filling the end before risking to stop up a fine canal with a second and larger cone, I take a radiograph. Fig. 6 shows a case of this character, just the end of the canal being filled.

I find this good practice also in young teeth where the canals are very large, and the foramina also large. In such

cases I sometimes flood the canal with chloro-percha mixed quite stiff, and then introduce just a part of a cone which is carefully pressed to place to seal the foramen. This is left for two or three days to harden before the canal proper is filled, and for the reason that where a canal is so large that a great mass of gutta percha must be utilized, there is danger of forcing too much through the large foramen. Fig. 7 shows two central incisors with just the apical foramina sealed. (The dark blotch seen lower down is due to the smear of chloro-percha in the canals.)

Dr. Callahan showed us a specimen in which his resin had filled an unexpected canal. In Fig. 8 is seen the radiograph of a first upper bicuspid filled out of the mouth. The tooth, of course, was known to have two canals, but it was not known that these two canals were united centrally of their length, by a thin passageway, until it was discovered with the X-rays. Chloro-percha was first placed in the canals, and evidently the gutta percha points when pressed in, forced the chloro-percha into this by-way. I shall look forward with interest to further communications from Dr. Callahan on this great subject.

Dr. W. B. Dunning—Although Dr. Callahan refers to the subject of the filling of root canals as being timeworn, it is, nevertheless, true that it can never be worn out by time, or that this subject can have become of less than capital importance to the dental practitioner. We are, therefore, much indebted to Dr. Callahan for his interesting presentment this evening of a method of root canal filling which, in several of its details, may be called essentially new. The melting of resinous substances into the pulp canal was attempted many years ago, and abandoned chiefly because of the sticky and unmanageable nature of heated resin. The solution of this substance in chloroform is new, so far as my knowledge goes, and it suggests very attractive possibilities.

I believe we have realized for many years that the ideal root filling, when it is found, shall be liquid at the time of insertion, and capable of solidification without loss of bulk a short time after insertion. There are many other require-

ments which are well understood, but we must bear in mind the prime importance of sealing absolutely the entire surface of the canal, from apical end to orifice, with an impenetrable and impermeable substance which will never thereafter change its form.

Solidification through cooling involves less loss in bulk than solidification through evaporation. When a mass of paraffin, for instance, in a liquid state is chilled and becomes solid, there is, to be sure, a definite amount of shrinkage, but that amount is almost negligible as compared to the shrinkage of chloro-percha from which the chloroform has evaporated. Furthermore, the paraffin in the process of shrinking, clings to the periphery of the root canal, or the vessel containing it, and becomes depressed toward the center, so that, in spite of the shrinkage, there is still an absolute fit of that mass of paraffin against the wall of the tooth. On the other hand, as chloro-percha, or gutta percha more or less associated with chloroform, undergoes its shrinking process through evaporation, the mass of gutta percha shrinks upon *itself* and leaves a crack at the periphery, varying, of course. with the bulk of the material.

Just here, Mr. President, I must confess myself in the infant class, because I still feel that the example of a bottle containing some evaporated chloro-percha is instructive. I think I shall not shrink, as the gutta percha has in this bottle, from following out the point, that where there is *any* evaporation there must be shrinkage.

Dr. Rhein states that with him the solid point is so inserted in the canal that no chloro-percha remains. or that he sees to it in some way that there is no evaporation after the point is inserted. This seems to me a remarkable feat—beyond my ability and that of most operators. Of course, if any chloro-percha is left in that canal some evaporation must occur, however infinitesimal.

I have here two bottles—one containing a mass of paraffin which was chilled, the other containing some gutta percha which was formerly in solution in chloroform and eucalyptus, and which has since dried out. The difference which I am

trying to explain is very graphically shown by these two specimens, in which the paraffin remains in contact with the inner wall of the container, and the gutta percha has become a shrivelled mass, rattling about in the bottle.

The point will be made at once that we are dealing with minute root canals, and not with bottles three-quarters of an inch in diameter, and that the relative shrinkage of a gutta percha root canal filling would be so microscopic as to be negligible. I have also in mind the fact that cones of solid gutta percha are usually employed to fill the major part of the canal, and that in placing them, most of the chloro-percha is crowded out and removed. I think, however, we are all so familiar with the odoriferous character of many gutta percha fillings which have been removed after years of service, that the suspicion is a valid one that this peripheral crack caused by shrinkage is not altogether a negligible factor in our present discussion.

I cannot speak from experience concerning the use of rosin in solution. I can imagine that from its sticky nature it might, upon the evaporation of the chloroform, cling tenaciously to every particle of the surface with which it was in contact, and so permanently seal the dentinal tubuli. Furthermore, if Dr. Callahan actually succeeds in forcing the rosin not merely into these tubuli, but throughout their entire length, this, I think, would give us assurance that no stray bacterium lost in the mazes of those minute tubes could ever have the remotest chance of escaping therefrom. In other words, such bacteria would become embalmed forever, like flies in amber, and this is the same as admitting that the dentin of a tooth so treated would be permanently sterile.

I have always felt that the paraffin filling, when inserted in accordance with the technique suggested by Dr. Prinz, and particularly when this filling is supplemented by a cone of cold gutta percha thrust through the liquid paraffin and allowed to remain—that such a filling comes very near to being the ideal toward which we are working. It is quite possible that Dr. Callahan's solution of rosin will serve every purpose of the paraffin, and be capable of greater penetration into the

dentinal tubuli. There will be some advantage in being able to use this material at the mouth temperature, since that does away with the necessity of an electrically heated copper wire used in introducing the paraffin.

Anything coming from Dr. Callahan is entitled to our most respectful attention. I trust it may not be out of order for me to record at this time my personal sense of indebtedness to him for suggesting the use of sulphuric acid in opening root canals. I regard this as one of the most revolutionary and important steps that has ever been taken in the intricate and delicate and laborious work of successful root canal treatment.

Dr. N. T. Shields—This very beautiful paper that we have heard this evening, accompanied with the slides, together with the discussion of these gentlemen, only proves what I have been trying to teach you for a great many years from my own clinical experience—namely, to thoroughly mechanically clean the canal with suitable broaches. When the canal is clean, thorough asepsis being maintained throughout, fill that apex by exact measurement with non-cohesive gold foil, and you absolutely eliminate any possibility of irritation through the filling being forced through the apex into the apical space. I fill the remaining portion of the canal with oxychloride of zinc, which through its affinity for moisture fills the tubuli. In my hands this scientific method of root filling has been a success for over a quarter of a century. In all this paper and the discussion that followed there was not one single apical filling to prevent the rosin solution and gutta percha from being forced through the apex.

I make these few remarks, feeling that the ideal root filling is an absolute stop at the apex, wherein no root filling, it matters not of what nature, can possibly be forced through into the apical space, so that the alveolus will remain in a perfectly healthy condition. In my hands, there is nothing that fills the canal proper and also the tubuli better than the method above described.

Dr. Rhein—Dr. Ottolengui made some criticism about the correct use of the word Röentgengram, and I would ask him

to go up to the library, and look at the *Journal of the American Medical Association.* He will find that at a meeting of the Röengten National Association, in a discussion of this kind, the nomenclature which they adopted was Röentgengram. In his editorial capacity, I want to call his attention to that fact particularly.

Before taking my seat, I want to say to Dr. Dunning—and what I have to say would have been said without regard to our conversation—that I did not feel there was time tonight to give the correct technique of a proper gutta percha filling; but if he takes a magnifying glass and examines the negatives of some of these root fillings, I will defy him to find any contraction of the gutta percha. This is simply getting rid of the chloroform and compression at the same time.

I do want to reiterate one point. The last speaker seemed to fail to understand that in studying the bacteriology of this question, which must always be the one guide we have in view, we must remember that the ideal root filling must include the end of the root; and the moment you fail to get your root filling in the apical space when you have any appreciable space you have a defective root filling.

Amongst all the Röentgengrams I have of gold root fillings, I fail to find one good root filling. I would like to see one that is good, in order to show that one can be made. If you have an appreciable opening of the end of your canal, you have the possibility of liquid seeping into the canal, and that is where your infection comes from. I simply desire to nail that point, that a proper root filling cannot be put into a canal unless all possibility of seeping liquid in the canal is obliterated. A non-irritating material that is compatible with the living tissue such as *gutta percha* is, can with perfect safety be forced some distance through the canal. Infection, however, is always invited if the minutest opening remains unsealed at the apical end.

Dr. Dunning—At the completion of your operation of filling a root canal—when the last cone is pressed into place and condensed—do you think there may still be a trace of chloroform remaining anywhere in that canal? As a matter of fact, are you confident that *no* chloroform remains?

Dr. Rhein—No; I believe there is none.

Dr. Dunning—Do you not think most operators fail to get rid of the last trace of chloroform?

Dr. Rhein—There ought not to be any if an intelligent technique with gutta percha is carried out.

Dr. Dunning—It seems to me impossible at a single sitting to remove all chloroform from a canal by means of a substance which is attacked and partially dissolved by that liquid. Great pressure may be applied, but some of the softened gutta percha remains, and the odor has not gone. It is my conviction that subsequent evaporation occurs, be it more or less according to the operator's ability; and that a varying degree of porosity must be the natural result.

Dr. Shields—Dr. Rhein wished to nail the point that a proper root filling could not be introduced into a canal, with gold at the inside extremity of the canal. I wish to clinch it on the other side with this positive statement—that a root is infinitely better where a man is so skilled in instrumentation as to be able to define the point just before you reach the pericemental membrane surrounding that root, so that when the gold foil is positively packed gently at that apex, leaving the anatomical space at the apex of the root the same as it was before the pulp was devitalized—this is infinitely better than to penetrate that root at its most critical point and allow the slightest extension of gutta percha into the apical space. A root positively filled with gold to the apex, not through the apex, and the canal and dentinal tubuli with oxychloride of zinc is in my hands the ideal root filling.

Dr. Chayes—I should like to have the Executive Committee ask Dr. Shields to give us a paper, showing us radiographs of these roots filled with the gold plugs at the end, because if that is the correct procedure, I think it is time for us to accept his method and fill root canals in this manner. I would ask that the Executive Committee appoint a time when Dr. Shields can give us a paper illustrating the ends of the roots, all of which have been filled with gold plugs subsequently followed up by oxychloride of zinc.

President Gillett—That suggestion will necessarily be

passed on to the next Executive Committee, as this year's programme has been filled.

Dr. L. C. LeRoy—I wish to thank Dr. Callahan for what I have got from his paper this evening, and also pay a little tribute to those who have labored in other fields.

His method of enlarging pulp canals by the use of the sulphuric acid method has revolutionized our practice, particularly upon the smaller pulp canals, and we hope that his contribution of to-night will do as much in another direction.

Until one masters the technique of pulp canal treatment and filling, devitalized teeth remain terrors.

In the main, the three greatest problems we have to solve in the treatment of them are the accessibility to the apical space, the sterilization of the dentinal tubules and the sealing of the apical foramen.

Dr. Callahan's sulphuric acid method solves the first problem in the majority of cases—and the second problem, too, where it can be used, or other antiseptics, such as bichloride of mercury or carbolic acid—deliquesced—etc., may be preferable to many. The third problem—the sealing of the apical foramen—is in reality the crux of pulp canal treatment. The problem has been to find something that will remain chemically efficient, permanently antiseptic, and which will remain mechanically dense enough and be impervious to fluids.

Dr. Callahan's latest contribution, rosin solution, may do this perfectly, but it has always been my feeling during the period that I used chloro-percha, that the evaporation of the chloroform interfered with the gutta percha in such a way as to leave the mass disintegrated and granular in its character, which makes that material unfit for pulp canal fillings.

Any substance which evaporates very rapidly seems to impart the physical properties of great shrinkage and porosity to the thing acted upon. There are many like myself who are afraid of chloroform or ether used as a solvent on this account.

I still feel from the almost perfect results obtained after many years of use that nothing more satisfactory has been

given to us than eucalyptus oil, as a solvent for gutta percha.

When eucalyptus oil was suggested to us I perfected in my own way—although probably not previous to many others—a method of dissolving gutta percha in that material, using only enough of the oil under the influence of a hot water bath to incorporate it with the gutta percha.

When making the solution about 5 per cent. of aristol is stirred in, or hydronapthol may be used. Eucalypto-percha prepared in this way becomes quite hard upon cooling, so that it requires to be reheated each time before using; it can be placed in the instrument sterilizer just before you need it.

The pulp canal to be filled should be lubricated with eucalyptus oil on a cotton covered broach before the introduction of the eucalypto-percha.

For many years I have been using this particular method of root canal filling, of course always carrying a gutta percha point to the apex of a root, or as far into the canal as it will reach. I have also met with the objection that Dr. Ottolengui states of the gutta percha points not being of the proper shape to be received into pulp canals, but have endeavored to overcome that difficulty by rolling them under a broad spatula on a glass slab that had been heated, and also the spatula slightly heated. It is very simple to roll them out to the desired diameter, occasionally trying the cone into the pulp canal before any eucalyptus or other ingredient has been introduced.

The other uses that Dr. Callahan suggests for the rosin solution makes it a very valuable adjunct.

I do not underrate the value of what Dr. Callahan brings us. Rosin solution and gutta percha may be the system par excellence; let us try it out.

I wish to extend my personal thanks to Dr. Callahan for the privilege of listening to his able paper.

Dr. Stewart—I rise to address you with mingled feelings of pleasure and embarrassment—pleasure, for the privilege of being able for the first time in my life to listen to Dr. Callahan, a man who has done not only the profession, but our patients, so much good; and embarrassment, in my relations

to this Society, or rather my non-relations, for I am not enrolled as one of its members.

I have been a little surprised to note that no one but Dr. Dunning said anything to really thank Dr. Callahan for the great service he has done the profession by his sulphuric acid treatment, for whatever we may think of his root canal fillings, this has certainly been invaluable to humanity; if we consider it only from the standpoint of the prevention of the absorption into the human system of countless billions of poisonous micro-organisms from abscesses that would ensue from the imperfect opening up of root canals.

There was one point I would like to ask Dr. Callahan about. He said he did not always fill these canals to the ends of the roots. It reminds me of a conversation several of us had the other night with Dr. Levy, just after the last meeting. Dr. Levy was very enthusiastic in what he said of cutting off the ends of the roots of teeth and the method by which he takes radiographs of these roots. He became so enthusiastic about it, that he seemed to suspect some of us did not agree with him entirely, and finally he invited me up to his offices, and I must say that I was very much pleased and instructed with what I saw there.

Just one point about root fillings. I remember a great many years ago, Dr. Darby said: "Gentlemen, fill your root canals first, last and always with oxychloride of zinc," and I have adhered tolerably rigidly to that; and I have had no cause for regret. I think it will do all in the way of antisepsis, in the way of sealing root canals, that we could hope for from any of these materials, and as to the objection so often alleged—"What are you going to do if you have trouble?" I will simply say that if properly handled you will have very much less trouble from this material than any other. I think it is well proven that there is absolutely nothing that we can introduce into a tooth that will so effectually prevent the ingress of micro-organisms into that tooth as oxychloride of zinc. It adheres to damp walls, and we do not have that trouble of conforming to the different root shapes spoken of by Dr. Ottolengui, neither do we have that odor when taking it out.

Dr. Ottolengui—Why do you take it out?

Dr. Stewart—If it pleases you better, I will say *if* you take it out. I might ask you why do you take gutta percha out. I would add that I think Dr. Callahan has the best method in the world of opening up root canals, and from what I have heard to-night, *next* to the best method for filling them.

Dr. J. M. Levy—At the last meeting of the section in crown and bridge work, I discussed with some of the men, after the meeting, the various methods that had been proposed for doing this work. I was very free to confess that I did not always succeed in filling root canals to the apex, and when they asked me what I did when I found I could not do so, I told them I made it an invariable rule to amputate the part that I could not fill. That statement led to the question as to whether I was foolish or untruthful.

I thought Dr. Stewart doubted me and I showed him a case where I had to do this work on the roots of the lower first and second molars. He was present when these amputations were done.

What I wanted to bring out principally was the great danger which might ensue if we allowed these partially filled canals to produce the blind abscesses Dr. Rhein has spoken of. I believe that in all cases where we cannot insert a perfect root filling we should amputate that portion of the root which we find it impossible to fill.

Dr. Andrew Asch—May I ask the last speaker whether he amputates the roots of second molars and wisdom teeth, and if so, how he does it?

Dr. Levy—I certainly amputate the roots of second molars, but not of the wisdom teeth. I extract the third molar at the first indication of trouble after I have filled the roots as well as I am able.

Dr. Callahan—I have been very much interested, of course, in this discussion. The main object in my paper was to indicate, to exemplify, or to satisfy myself and others of the diffusability of the rosin and chloroform solution, or the possibility of sealing the dentinal tubuli. The best slides I could have for that purpose I could not bring with me, and I ask some of you to tell me of somebody who can take my

slides and prepare photo-micrographs on order. I cannot get them in Cincinnati. That to me would be worth my trip to New York.

In this work a transverse section of a root canal filled in the way I spoke of, if it is ground thin and placed under a microscope, will show the diffusion of the rosin much better than any of the pictures I could throw on the screen this evening; and it shows, too, that the rosin solution does not go clear to the end of all the tubuli, because we know that these canals get so very small toward the cementum that it seems to be impossible to get anything into them; yet I have found cases under the microscope where the rosin will go further than this color I have used. Nothing but the microscope will show that.

My principal mission at the present time is to show that it does penetrate the tubuli. This is the main point.

As to the sterilization of the tubuli, since I have sat here I have wondered how it is that a man who thinks he knows a little about a subject, sometimes forgets—overlooks—very important points, and when Dr. Rhein spoke of the use of cataphoresis and the sterilization of teeth—that to me is a very rational procedure. I do not see why we do not use it more. I used to use nitrate of silver for certain purposes, but we want to get to something else. When I said that a perfect root canal filling had not been proven—I was speaking in a very general sense, not of what the individual or expert can do. I think I said a great many very satisfactory fillings had been made with gutta percha; and I know to a dead certainty that Dr. Rhein has made a great many fillings of gutta percha that are absolutely perfect. I have seen some that have been in the mouth in service for a long time; yet in the general sense, taking the profession at large, gutta percha has not been as successful as it ought to be; and it has been a matter of technique. I agree absolutely with Dr. Rhein in that point, and I think at the same time that rosin solution properly used and understood, will assist very materially in that technique.

If it does not prove to be useful, I want to be the first to know it. I have not anything to sell, or any idea to protect

in any way. I am simply seeking what is best in my own practice, and when I find anything I think is better, then I want to tell others about it; and when they do not approve it, or if they succeed in disproving its usefulness, I want to be the first to discard it. It does not hurt my feelings so long as I feel it to be an advancement toward truth. I do not care who points out the way.

Dr. Ottolengui threw a few bricks at my conical root canal preparation. Now I want to confess right here, that very often to reach the apex so that I can get anything into it, or to get to it to treat it as I think it ought to be treated, I sometimes have an awful time, and sometimes I do not get through at all. I have slides here in the box that I did not throw on the screen, because I felt I was taking too much time; but I have some pictures there showing teeth where I tried to get clear through to the foramen with them in my hand—a distinct advantage—and I have not got there yet in one or two of them. If I can get a canal in the general shape that I have indicated, so that I can work at the other end with some freedom without instruments locking, then I feel I have made some progress. That is the idea of speaking of the conical shape, or the ideal shape for a tooth canal.

I wish to return my thanks for your very courteous treatment. Dr. Ottolengui in a manner peculiar to himself said that you were threatened with another paper. I was unfortunate enough to say that I was not through with this subject. I feel that sulphuric acid is just as much misunderstood as a great many other things. It has been my pleasure to address dental societies over this country, and I have had a great many peculiar experiences along that line. A man said to me: "I used your sulphuric acid treatment in a tooth, and in six months after that, the whole top of the tooth dropped off." Mr. President and gentlemen, again I thank you.

Adjournment.

Frederick C. Kemple, D.D.S.,
Editor, First District Dental Society.

FIRST DISTRICT DENTAL SOCIETY STATE OF NEW YORK

Section on Crown and Bridge Work, Porcelain and Gold Inlays.

A meeting of the above Section was held at the Academy of Medicine, 17 West Forty-third Street, New York City, on Wednesday, January 21, 1914, at 8 p.m.

The Chairman introduced the speaker of the evening, Dr. Lester F. Bryant, D.D.S., of Chicago.

Dr. Bryant, in discussion, said he always used White's 22K solder; it works nearest to steel, is quite hard and stands mastication, can be finished and polished without distorting.

Do you use all gold for casting? Yes, in all practical bridge work and inlays. It is all cleaned, saltpetered and melted down on charcoal blocks, boiled in borax, etc.

What do you use for repolishing? Go over with emery disc and pumice stone.

Do you bevel the root? Yes, a little.

In anterior bridge work, to get the cleansing space—can this be done? Yes, to a great degree, and without disfigurement.

Dr. Bryant said he used the direct method for all inlay work.

W. D. Tracy, D.D.S.,
Chairman of Section.

See Dr. Bryant's paper, "The Mechanical Construction of Crowns and Bridges," in full at p. 100.

THE JOURNAL OF THE ALLIED DENTAL SOCIETIES

WILLIAM B. DUNNING, D.D.S., *Editor*
S. ELLSWORTH DAVENPORT, JR., D.M.D., *Associate Editor*

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EDITORIAL DEPARTMENT

THE SCIENTIFIC METHOD

The days of dragons are gone by; the Garden of Eden and the miracles of old are become symbolic poems in our widening view. The acceptance of Authority, inspired or profane, as a basis of knowledge, has been falling out of grace in these latter days. Man's native soil, intellectually, was an immemorial morass of half knowledge, born of imperfect sense and a lively imagination, wherein he floundered as a prophet and a seer. Only during a few brief centuries has he touched

foot upon the stone-carved steps that lead to the City on the Hill.

Galileo, Columbus, Darwin, Pasteur, were observers of facts. Each undertook the unpopular task of seeing and announcing things not recorded in the books of the sages—of upsetting comfortable and long cherished doctrines. They received the thanks usually accorded to such meddlers—and with each, mankind found another step cut in the rock. The blindness of the human eye is a curious thing, but the inbred resentment at having to see the light is a still greater mystery in our altogether wonderful constitution.

There is so much in dental science and art which has grown from finger skill, native mechanical instinct and personal tradition, that our practice is largely empirical. We must think at our finger-tips, it is true, but we should beware of overconcentration in that direction. The principles underlying methods of practice should be examined at all times, and brought into touch with the most recent theoretical knowledge. That knowledge, or rather the inferences deduced by our investigators, should stand upon a groundwork of facts obtained by the most approved experimentation, and without the bias of personal opinion. These should be checked by clinical tests, accurately and with a mind to the facts alone. This we must do if we are to grow in scientific stature: it is the order of the day; the road upon which all learned professions advance.

Fortunately a distinct impetus has been given by recent workers. The study of principles underlying anatomical articulation by Gysi, Snow and others is making itself evident in rationalized prosthesis. The hinge-joint articulator a few years ago not only was "good enough" for our best operators—it was the only one to be had of working value. At that time a knowledge of the true condyle path, of cusp incline and of correct occlusal horizon seemed a matter of pure academic interest; now the operator who fails to provide for these important factors in his work cannot be considered in touch with modern requirements.

Our specialists in orthodontia have given us new ideals in occlusion, which now must be observed by the general practitioner. The cast inlay has made it possible to embody these ideals in daily practice.

A distinct advance in the esthetic aspect of prosthetic dentistry is recorded in the present number of THE JOURNAL.[1] The array of facts presented by Dr. Williams is impressive, and his argument, supported by such evidence, quite demolishes the flimsy temperamental scheme of tooth forms outlined in our textbooks and taught in our schools. His position can only be upset by an equally great number of observations of actual tooth forms which conflict with his findings.

Perhaps our greatest strides have been along the lines of preventive medicine and surgery—of the study

[1] See p. 1.

of the nature of dental caries and of the full significance of oral sepsis. Wallace,[2] Pickerill,[3] and notably in a recent report, Gies,[4] have revolutionized former notions as to factors controlling the incidence of caries, and have advanced theories of prophylaxis which would have been heretical enough a few years ago. The records of many observers are leading to a knowledge of the ill effects of mouth-bred bacteria or their toxins upon distant organs—with a view to the possibility that many grave systemic disorders may be traced to tooth lesions. The evidence necessary to establish real knowledge in these wide fields may only be had through the most painstaking research covering many years. It must be compelling from sheer bulk after every test for error has been applied.

We are moving at an increasing speed toward responsibilities little dreamt of five years ago. We must secure normal occlusion, prevent dental caries and abolish oral sepsis. We know enough to know that these things may be possible—that the opportunity may rest with us to relieve our fellow-beings of their most widespread disease and to remove one of the greatest sources of deadly infections.

[2] Wallace: Supplementary Essays on The Cause and Prevention of Dental Caries, 1906.

[3] Pickerill: Prevention of Dental Caries, 1912.

[4] Lothrop and Gies: *Journal of the Allied Dental Societies*, VIII, p. 283.

NOTES ON PRACTICE

Compiled by William D. Tracy, D.D.S., New York City.

Deodorizing Iodoform.—The odor of iodoform may be removed from the hands by wetting them in water, and then applying a small quantity of potassium carbonate and two or three drops of ammonia water. The odor will entirely disappear.—*Cosmos.*

Restoration of Interproximal Space.—An abnormal condition that often requires correction by the insertion of a filling is that of the flat contact point, as yet free from decay, but causing great distress by accumulating food particles, especially of a fibrous character, in the interproximal space. An occluso-proximal cavity should be formed, separation secured, and the correct contact supplied. In contouring with filling material, the result aimed at should not be the restoration of the original form of the crown so much as to preserve the proper form of the interproximal space and to prevent food from wedging into this area.—E. S. Packard, *Dental Summary.*

To Prevent Discoloration by Boiling.—Complete elimination of discoloration and injury to instruments which are to be boiled can be accomplished by the use of caustic soda in the water; even though they are not wiped, there will be no rust.—L. K. M.

Usable Gold Plate from Gold Fillings.—While the coarser clippings from the gold drawer may be melted under the blowpipe into a button, flattened and rolled into plate, the finer fillings require preparatory treatment. They are apt to be contaminated with dirt and base metals, and if placed under the blowpipe for fusing, are usually blown away before fusing. First boil them in nitric acid until all red fumes disappear. Carefully pour off the acid and wash them with several changes of clean water. It is a wise precaution to filter the washings, as, if not carefully done, considerable gold may be lost by the fine particles floating off during this washing. Dry by a gentle heat, place them in a borax-lined crucible, and fuse in a gas furnace. If the quantity is small, the fusing may

be done in one of the smallest size clay crucibles with the blowpipe, directing the flame under the crucible. When fused, if not more than a few pennyweights, let it cool in the crucible and forge the button flat, then use the rolling-mill. For larger amounts pour into an ingot mold. If the melt proves brittle, use as a flux sal ammoniac or corrosive sublimate. When using the latter be careful not to inhale the fumes.—W. H. TRUEMAN, *Dental Brief*.

Iodine Stains.—Should, through any accident, iodine stains get on the linen of the patient while in the chair, the application of hypo, or fixing solution used in developing, will cause prompt removal.—L. K. M.

A Porte-Polisher for Holding Orangewood Points.—To construct a useful porte-polisher for orangewood points, cut the hub from an old hypodermic needle and solder it to the shank of an old cone-socket instrument. The orangewood "pegs" can be readily inserted by screwing them into the hub, the threads holding them securely. By placing this on a cone-socket handle, a substantial porte-polisher is obtained. I make them for patients to use at home in prophylaxis treatment.—R. L. HESSER, *Dental Summary*.

To Relieve Iodine Burns.—If the mucous surface becomes blistered by the use of iodine, an application of starch or flour in paste form will combine and form starch iodide, this being harmless.—*Cosmos*.

Retaining Appliances in Orthodontia.—The retaining appliance is fully as important in orthodontia as the original apparatus for correction—in fact more important, for the teeth *might* be moved into place with a very indifferent appliance, while the retainer *must* meet certain requirements, else the teeth will move back toward their old positions, and the case end in dismal failure. Every practitioner with any experience in orthodontia knows this to his sorrow. Yet the beginner is likely to estimate the retaining appliance very lightly, and runs a much greater chance of failure through a poor retainer than through a poor regulating appliance. Therefore make the retainer with as much care as a piece of bridge work;

make it strong enough; and lastly, leave it on long enough to do some good—at least one year.—*Western Dental Journal.*

To Remove Amalgam Fillings.—The application of heat by the use of a blunt instrument to amalgam fillings which are to be removed will facilitate the bur in doing its work. The cutting should be started at once after the heat is applied.—*Cosmos.*

Simple Device for Preventing the Contamination of Sterile Solutions.—Sterile solutions are often put into carefully sterilized bottles, closed with sterile stoppers, and then set aside. By the time the solutions are to be used dust has collected on the lips of the bottles, and in pouring out the contents the germs are washed off, and the solutions are no longer sterile. Wiping the top of the bottle at best removes only part of the germs, and drops the rest of them directly into the bottle. Then the stopper is laid down on some unsterile surface, and, loaded with micro-organisms, is returned to the bottle.

To obviate this, a round piece is cut from heavy rubber sheeting—that from a hot-water bottle answering best—this piece to be of such size that when it is placed over the mouth of the bottle the edges project somewhat. Then a small round hole is cut in the center, of such size that the rubber is with some difficulty slipped over the stopper. When the stopper is then returned to the bottle, the rubber covers the lip and extends a little beyond, thereby keeping off all dust. Evaporation of the bottle's contents is also prevented.

Another advantage is that the stopper may be laid down without the inner end resting on the unsterile table, as the rubber acts much the same as the rest on a carving knife.—A. G. BETTMAN, *Jour. of the Amer. Med. Association.*

To Support Loose Teeth While Drilling.—When difficulty is encountered in surgical treatment of a tooth loosened through loss of alveolus, a modeling compound impression of the tips of one or more adjoining teeth on either side, cooled and replaced, will aid in supporting it and give comfort to the patient during the sitting.—*Cosmos.*

The Faradic Current in Dental Diagnosis.—A tooth may appear to be in a normal and healthy state, and it may respond or not to thermal change and other tests, and yet the pulp may be dead. The faradic current will give positive and instant results, and will show whether the pulp is living or dead. The equipment necessary is any style of faradic battery, connecting cords, a hand electrode, and a broach-holder that is thoroughly insulated from the hand of the operator.

Wrap a few fibers of cotton on the broach, place the hand electrode in one of the patient's hands, wet the cotton on the broach, thoroughly dry the tooth to be tested, then apply the point of the broach, holding wet cotton to the tooth at a point nearest to the pulp, being careful to not allow the electrode to come in contact with the soft tissue of the mouth, which would cause a disagreeable shock to the patient. If there is a metal filling in the tooth to be tested, and it is not in contact with the adjoining tooth or touching the gum tissue, or can be thoroughly insulated from both by the use of mica or rubber dam, the test can be made through the filling, it being in contact with the dentin and being a better conductor than the enamel of the tooth, which is a very poor conductor of electricity. On applying the faradic current, if the pulp is alive, a slight shock will result, but if the pulp is dead, there will be no response to the current.—J. C. Parr, *Dental Summary*.

CURRENT DENTAL LITERATURE

COMPILED BY C. FRANKLIN MACDONALD, D.M.D.

EXPERIMENTAL EVIDENCE OF VARIATIONS IN ALIMENTARY SECRETIONS AND THEIR PATHOLOGICAL RESULTS. By H. P. Pickerill, M.D., Ch.B., L.D.S.—*Interstate Medical Journal, St. Louis, January, 1914.*

Dr. Pickerell's intention in this article is to show an intimate relation between salivary digestion and secretion and the rest of the alimentary secretions, physiologically and pathologically.

As a résumé of his previous work he first shows how various foods, as apple, orange, pineapple, stimulate the amount and alkalinity of saliva as compared with bread, butter, cake and meat. Next he shows the effect of taste stimuli alone, using flavored biscuit; demonstrating that saccharin, salt, acid potassium tartrate causes an increase, while carbonate of soda and tannic acid cause a marked diminution. Oil of clove, as characteristic of an aromatic, has no appreciable effect. Effects of liquids are likewise charted; ale, acid potassium tartrate and whisky produce an increase, while milk, tea, and water cause a decrease.

A series of tests are made in which the taste perception is dulled by partially cocainizing the afferent nerve endings of the tongue, showing the importance of the "glossopharyngeal-chorda" reflex arc in the stimulation of salivary flow. Variation in ptyalin content of saliva is discussed, with its converting action upon starch, and possibility of its continued action on the stomach. In his summary he expresses his belief in the "post-eruptive hardening of enamel by impregnation of the outer strata of enamel with lime salts."

Following the experiments upon saliva, Dr. Pickerell briefly summarizes the works of eminent physiologists relative to gastric, pancreatic and biliary secretions, and shows that these secretions are increased by acid stimulations and

depressed or inhibited by alkalies; that "in general terms their stimulants and depressants are identical in nature."

The importance of reflex stimulation is shown and the author gives a diagram of a reflex arc consisting of the glosso-pharyngeal-chorda tympani nerves, representing the afferent path, and the vagi the efferent path. Experimentally, division of the vagi below heart has been shown to result in definite pathological changes and the essayist believes that if on the afferent side of the arc there is blocking, pathological changes will likewise take place. In the human subject there are two ways of creating this block; first, that of habitual diet of a non-stimulating character, and second, burying of the nerve terminals of the tongue by the formation of a coating on its surface, thus preventing stimulation.

As to the result of a diet of a non-stimulating character, the author is conducting a series of experiments upon rabbits, feeding them boiled and neutralized food, using Na_2CO_3. While not finished, these experiments at this time seem to show definite facts, such as lack of development, excessive excretion of starch and calcium in feces, subnormal development of salivary glands, gastric lesions, marked dilatation and acute general gastritis.

The author deplores the present large consumption of alkalies in the form of drugs and food and presents a chart showing effects of a chalk dentifrice as compared with the action of acid powders or washes in the stimulation of saliva.

The coating upon the tongue is said to be identical with the deposit found around the necks of teeth; being mucin, epithelial cells and masses of organisms. This condition is helped by scant, viscid saliva or anything tending to depress the flow of saliva.

Dr. Pickerill then discusses his "Alimentary Vicious Cycle," which is summarized as follows: "Diminished oral stimulation produces oral stasis and sepsis initially, this in turn producing gastric and intestinal sepsis, thus giving rise to toxins, which being absorbed still further, increase oral sepsis and diminished taste perception and cause intestinal dilatation, which again increases toxic absorption."

SOME EXPERIENCES IN ANALGESIA. By Norman White, D.D.S. —*Commonwealth Dental Review, Sydney, Australia, December, 1913.*

Dr. White used the A. C. Clark & Co.'s New Model gas and oxygen machine upon about fifteen patients and now reports three of these cases which have caused him to give up this method of analgesia.

The first case was a female, age seventeen, robust health. Not having O available, opened air valve wide in nose piece. After working a quarter of hour with frequent rests from analgesia, she suddenly became anaesthetized. Could not get her fully awake for thirty-five minutes, and during the afternoon and evening she continued drowsy, sleeping during a train and boat trip.

The other two cases were girls of about sixteen, of nervous temperaments, but expressing perfect confidence in the method. After N_2O and O analgesia was brought on, use of bur in the one case caused crying, although she claimed no sensation of pain. Gas was stopped and although fully conscious, she could not stop crying for twenty minutes. With the other girl, after commencing operation under analgesia, laughing began, ceasing whenever work was stopped. Deeper analgesia was induced, but when work commenced, laughing began again. Gas entirely removed, but laughing still continued and it was only after forty-five minutes in a dark, quiet room that she recovered. For three days patient was inclined to hysteria and slight lapse of memory.

The doctor wonders if in certain susceptible individuals the mixture of N_2O and O may not excite certain centers under stimulation of pain, though pain is not apparent to the individual; also, if this is so, might not a case of insanity result?

A SUBSTITUTE FOR THE MISSING FIRST PERMANENT MOLAR. By H. W. C. Bödecker, B.S., D.D.S., M.D., Berlin—*Dental Review, Chicago, November, 1913.*

The author first discusses the movements of normal teeth and their relations to the mechanical principles upon which artificial substitutes, using inlay abutments, should be con-

structed. Three directions of movement are considered, bucco-lingual, mesio-distal, and vertical.

Dr. Bödecker feels that the principle involved in the method of overcoming these movements is best illustrated by considering the tooth as a nut and the inlay and connecting bar, as the head and handle of a wrench firmly adjusted to the tooth at right angles. This overcomes the bucco-lingual and mesio-distal movements; while to overcome the vertical movement he allows the end of bar, attached to inlay of one anchor tooth, simply to rest in a specially prepared inlay of the other tooth.

Practically, this construction is carried out by flattening the mesial and distal surfaces of one tooth with a diamond disc; these two surfaces are united occlusially by a cut of sufficient depth to receive a platinum-irridium bar of about one-sixteenth of an inch. The lost tooth substance is reproduced in wax; bar placed in position and in proper relation to other tooth; then wax pattern removed with bar and cast. When finished, this represents the head of wrench, the jaws being the portion upon the mesial and distal surfaces of the tooth, and the bar being the handle of wrench.

In the other tooth is placed an inlay, so carved as to allow end of bar to rest upon it, free from occlusal strike. Over the bar passing through the space, a tooth may be modeled in wax and cast. Provision can be made for a porcelain facing as wished.

This type of bridge the author has tested in a practical way for over three years. It is said to furnish a reliable anchorage without devitalization of pulp. The anchor teeth being separate, it but slightly impairs the normal movements of the teeth, and while filling the space with perfect articulation, puts no undue strain upon anchor teeth.

Accurate Method of Turning Rim on a Swaged Plate.

O. G. Krause, D.D.S.—*Dental Review, December, 1913.*

As the author states, a turned rim on a swaged plate affords better attachment for rubber than a soldered rim, it produces a smooth border and on a swaged aluminum plate is the only alternative. The old method of turning with pliers is difficult and tends to distort the plate.

After swaging plate in usual way, a trial plate is made of wax, carved to determine exact margin necessary, and with sharp edge. This is attached to swaged plate having surplus rim, the whole with exposed sides covered with plaster, wax replaced with Melotte's metal, and this cast used as a counter die against which to turn up the rim of swaged plate. Finished plate can be modified at border as necessary by filing counter die and then reswaging that portion of plate.

USE OF ALUMINUM IN DENTISTRY. By L. N. Roebuck, L.D.S. —*Commonwealth Dental Review, Sydney, Australia, November, 1913.*

Dr. Roebuck commenced using aluminum inlays in 1908 and feels much pleased with the results. One of the chief advantages is claimed to be their lightness and likewise, in large cavities, the reduction in cost of material. He does not believe in hollow gold inlays produced by wax suction methods, and says that in large cavities, solid gold inlays would in time drag out by their own weight. Another advantage is said to be the permanent, beautiful white frosted appearance more nearly in harmony with the tooth structure.

The metal is cast in a mold over an ordinary Bunsen burner and there is no necessity to have a red hot mold. Stirring the metal while melting is said to be essential owing to a film which forms over it.

Referring to cast base plates the essayist roughly presents the technic which is given in detail in Dr. Wilson's "Dental Prosthetics." He unfortunately gives no data as to his successes with the use of cast aluminum for base plates.

CURRENT NEWS

Items of professional news, of general interest, will be welcomed by the Associate Editor at 51 West Forty-seventh Street, New York City.

The annual dinner of the First District Dental Society of the State of New York was held on Saturday evening, January 24, at the Hotel Astor. There were over 150 gentlemen present, and the occasion was surely an enjoyable one.

President Henry W. Gillett started the proceedings by welcoming the guests in behalf of the society.

Following is the gist of what was said by the speakers of the evening, though the speeches are not quoted:

We should resent the universal exploitation of our profession by dental dealers, and the time is ripe for its members to organize for research to prevent worthless machines and preparations from being put on the market. "I regard with apprehension the wave of analgesia that is sweeping over our profession."

It is a satisfaction to see a spirit of investigation and research growing among the younger men, and it is a great pleasure to note that we, as a profession, are engaged at the moment in most important work along the line of preventive medicine.

H. W. Gillett.

The relief fund of the National Dental Association is used for the purpose of aiding those of its members or former members who are in need. Let me urge you to support this fund. Do you realize that we, as a profession, are denying men the privilege of interchange between States, so that men in ill health cannot, at the present time, go to a climate more suited to their needs and practice there, without passing examinations all over again?

E. S. Gaylord.

Not one person in a thousand understands what the Board of Regents is doing for the professions. New York State has for years sat on the long end of a lever bringing the other States up to a decent standard of educational requirements. The Board of Regents stands between you dentists and men who are trying to drag down dentistry to the level of a business.

The Board of Regents is not afraid to reverse itself whenever it will do justice by so doing.

There are men in the dental schools of this State to-day who never should have been admitted by these schools. They have been enrolled that the schools may get their money.

I am absolutely in favor of the annual registration of dentists, in order to put out of business the fellows who have no ethics or professional souls in their practice. I am in favor of reciprocity with other States, provided it *is* reciprocity.

I do not favor a four-year course in the dental schools unless the fourth year will give the students an education sufficient to recompense them in clinical experience for a year spent in practice.

If you dentists cannot agree as to legislation, better 10,000 times that you stay away from the Legislature and let us, the Board of Regents, make the laws. In order to accomplish anything, you must unite.

A. S. Downing (First Asst. Commissioner of Education of the State of New York).

Pennsylvania is falling into line and raising her educational standards. *I. N. Broomell.*

The general standard of dentistry in England, as understood by the people, is far lower than it was twenty years ago. Only 5,000 out of 16,000 dentists are registered or qualified. This is caused by the fact that the members of the profession cannot stand together. Concerted action is the secret of success in any great movement. *J. Leon Williams.*

Dentists should see the fact that they are professional and not business men, and should cease to exploit all the dental preparations on the market.

Giving effective, stimulating service is the thing to live for and the thing from which happiness comes. Aspire to be faithful, effective doctors and not popular money-grubbers.

I proposed some time ago that the society put in the hands of research workers many of the preparations on the market and find out just what good they are. *Wm. J. Gies.*

* * * *

Following is a report and tabulation of the work done in

1913 in the dental clinics under the auspices of the Bureau of Child Hygiene of the Department of Health of New York City, compiled by Supervisor Matthew F. Carney:

With a record of over 53,000 treatments, nearly 22,000 fillings and upwards of 13,000 extractions, in less than one year, the seven Municipal Free Dental Clinics of New York City entered upon the duties of 1914.

These clinics are under the direction of the Bureau of Child Hygiene of the Department of Health and afford free dental services to all needy school children of four of the five boroughs of New York City.

The clinics were opened on dates ranging from January 7 to February 4, 1913, but the annual report is based upon the services performed from their respective openings up to January 1, 1914.

At the present time there are seven of these clinics in operation in Greater New York. Six of them are served by salaried men, while at one, 689 Bay Street, Staten Island, the services are given gratis. Three of the clinics are double and four are single. The dental corps consists of nine clinical dentists and one supervisor, and two who render free service at Staten Island. The hours are from 2 until 5 o'clock, daily, except Saturday, when they extend from 9 a.m. until noon. The Staten Island clinic is only open on Thursday afternoons and Saturday mornings.

Each clinic is in charge of a graduate nurse or Registrar who is on duty all day. A corps of visiting nurses, varying from one to four in number, is connected with each clinic; its duty being to investigate all cases and to accompany the children to and from the schools. The preliminary examinations of the children's mouths are made in the schools by the school physicians and the children are instructed to have the work attended to, either by their private dentist, or at one of the municipal clinics.

It has been found necessary to limit the attendance at the clinics to children between six and eight years of age, as it is hoped that decay in the second dentition may be greatly reduced by putting the mouths in a hygienic condition at this most important time of life. The department felt that it could render greater and more lasting service to a larger number by so restricting the attendance.

There are certain sections of the city that are in crying need of dental clinics, as, for example, there are nearly 100,000 school children in the Bronx and only one clinic with one dentist to care for them; the Borough of Queens has no clinic; Richmond has one; Brooklyn only three, manned by four dentists.

The work is in its infancy, but it is hoped that when the splendid results, shown in the following data, are brought to the attention of the

proper authorities, that there will be a big increase in the number of clinics and also in the equipment.

	449 East 121st St.	164 2nd Ave.	580 East 169th St.	330 Throop Ave.	1249 Herkimer St.	124 Lawrence St.	689 Bay St., S. I.	
No. registered....	1,867	1,478	900	1,161	769	887	205	7,267
No. discharged...	1,043	1,433	892	878	750	695	80	5,773
Normal	24	26	6	43	1	0	11	111
Cured	872	693	601	796	380	496	59	3,897
Dropped	149	714	285	39	369	199	10	1,765
No. extractions..	3,270	2,347	1,778	1,762	1,525	1,944	394	12,960
Deciduous	2,741	1,951	1,439	1,337	1,234	1,450	286	10,438
Permanent	529	396	339	365	291	494	108	2,522
No. fillings......	6,279	4,412	2,698	1,846	2,711	3,784	159	21,889
Temporary	1,168	1,109	400	267	976	1,222	51	5,193
Permanent.....	5,111	3,303	2,298	1,579	1,735	2,562	108	16,696
No. treatments...	15,918	10,025	7,902	4,818	6,921	7,198	291	53,073

* * * *

Relative to the dental nurse in Massachusetts, two changes in the law bearing upon this important question have been recently advocated by the men for and against the dental nurse.

First, the anti-nurse practitioners are responsible for the following proposed amendment to Section 29, which was introduced by the Massachusetts Society for Advancement of Mouth Hygiene:

Section 1. Section twenty-nine of Chapter seventy-six of the Revised Laws, as amended by Chapter two hundred and nineteen of the Acts of the year Nineteen Hundred and Three and by Section two of Chapter two hundred and eighty-nine of the Acts of the year Nineteen Hundred and Five is hereby further amended by adding at the end thereof the following:

Nor prevent a person, male or female, from cleaning the teeth of and teaching mouth hygiene to the children in public or private schools or institutions approved therefor by the Board of Health of the city or town in which such school or institution is located, which approval upon written application by the authorities of such school or institution said Board of Health in its discretion is hereby authorized to give, provided that such person is twenty years of age, of good moral character, has duly qualified by passing a satisfactory examination in the subjects of mouth hygiene, sterilization, transmission of infectious and contagious diseases and the cleaning of teeth, and holds a certificate to that effect from the Board of Registration in Dentistry, and upon the payment by each applicant of a fee of $5.00, which shall not be returned. Said Board is hereby authorized to make such examination and issue such certificate.

In opposition to this amendment, the Massachusetts Civic League has introduced before the Legislature a bill which embodies rather sweeping changes from the present state of affairs. The paragraphs in this bill relating to the dental nurse are given below:

Section 3. No person not a registered dentist shall directly or indirectly practise dentistry in the Commonwealth of Massachusetts, except as provided in this act.

It shall be unlawful for any person or persons to operate any dental office under any name or corporation name other than the name of the person or persons therein actually engaged in the practise of dentistry.

Any person shall be said to be practising dentistry within the meaning of this act who shall use the word or letters "dentist," "D. M. D.," "D. D. S.," or any other letter or title in connection with his name, which in any way represents him as engaged in the practice of dentistry, or who shall for a fee, salary or other reward paid or to be paid, either to himself or to any other person, perform dental operations of any kind, diagnose or treat diseases or lesions of the human teeth or jaws, replace lost teeth by artificial ones, or attempt to correct or diagnose malposition thereof, or who shall advertise or permit it to be done by sign, card, circular, hand bill, newspaper or otherwise, that he will perform any or all of the aforesaid operations.

But nothing in this act shall prevent any person from cleaning teeth under the direction of a registered dentist. The cleaning of teeth shall include only the removal of all stains and deposits from the exposed surfaces of the teeth and polishing said surfaces. Nothing in this act shall apply to treatment by a registered physician not practising dentistry as a specialty, nor prevent a registered dentist of another State or his assistant from operating at a public clinic under the auspices of a duly organized and reputable dental college or association, nor prevent a student of a reputable dental college, incorporated under the laws of this Commonwealth, from performing operations as part of the regular college course.

Below is that part of the present law that would be affected by the proposed changes. A comparison of all is interesting:

Section 28. . . . Any person who owns or carries on a dental practice or business, or who by himself, by his servants or agents, or by contract with others shall perform any operation on or make examination of, with the intent of performing or causing to be performed, any operation on, the human teeth or jaws, or who shall describe himself by the word or letters "Dentist," "D. D. S.," or other words, letters or title in connection with his name, or who shall advertise by sign, card, circular, pamphlet or newspaper, or otherwise indicate that he by contract with others, or by himself, his ser-

vants or agents, will perform any operation on or make examination of, with the intention of performing or causing to be performed, any operation on, the human teeth or jaws, shall be deemed to be practising dentistry within the meaning of this act, and unless duly authorized thereto by obtaining a certificate as provided in section twenty-six, shall be liable to punishment as above provided, and whoever in practising dentistry as above defined owns and carries on a dental practice or business, and in said business employs or permits any other person to practise dentistry as above defined unless such other person is duly authorized and exhibits his name and certificate as herein provided or who fails to exhibit his name as required by section twenty-six, shall for each offence be liable to punishment as above provided. The word "person" in this act shall include a corporation; and any corporation violating any provision of this act shall be liable to a fine as herein provided, and the officers of the corporation concerned in the said violation shall be liable to fine and imprisonment as above provided.

Section 29 [As amended by chapter 219 of the Acts of 1903, and section 2, chapter 289, of the Acts of 1905]. The provisions of sections twenty-four to twenty-eight, inclusive, shall not apply to a physician registered under the provisions of this chapter, and in actual practise as a physician, in cases where he deems immediate treatment necessary for the relief of his patients, nor prevent a licensed dentist of another State from operating at a public clinic under the auspices of a duly organized and reputable dental association nor a student of a reputable chartered dental college incorporated under the laws of this Commonwealth, and duly authorized to grant degrees in dentistry, from performing operations in the college infirmary as a part of the regular college course and in the presence, and under the actual instruction, of a registered dentist appointed as instructor.

BOOK REVIEWS

By C. Franklin MacDonald, D.M.D.

The American Text-Book of Prosthetic Dentistry. In Contributions by Eminent Authorities. Edited by Charles R. Turner, M.D., D.D.S., Professor of Mechanical Dentistry and Metallurgy, Department of Dentistry, University of Pennsylvania, Philadelphia. New (4th) edition, thoroughly revised and rewritten. Octavo, 856 pages, with 900 engravings. Cloth, $6.00, net. Lea & Febiger, Philadelphia and New York, 1913.

The American Text-Book of Prosthetic Dentistry, edited by Dr. C. R. Turner, is probably the most elaborate and one of the best known treatises upon the subject of mechanical dentistry that we have. It now appears in its fourth edition.

Great strides have been made in the field of prosthetic dentistry during the past few years, especially relative to anatomical articulation of artificial teeth, and also to a better appreciation of what mechanical devices for the restoration of lost teeth are called for, under various conditions. This present work seems to be a safe and conservative guide.

As a foundation for the treatise the tools and equipment necessary for prosthetic dentistry are first presented, then in two succeeding chapters some of the materials, as metals, alloys and porcelain, are considered; chiefly from the standpoint of the metallurgist.

Chapters IV and V take up in detail the human jaws and teeth in their relations to each other and to the individual as affecting speech, appearance and use.

Preliminary study of the mouth for the insertion of teeth, the taking of impressions, making of plaster casts, and the methods of molding and producing dies and counter dies are next considered in detail.

Chapters X, XI and XII are perhaps the most important from the viewpoint of our modern ideas upon anatomical articulation and embody in well selected details, the important facts necessary to the construction, arrangement and articu-

lation of artificial teeth. The theories of anatomical articulation as presented by Bonwell, Walker, etc., and the latest researches of Gysi, are considered and condensed so that they should present little difficulty to the average student.

Vulcanized rubber as a base for artificial dentures, by G. H. Wilson, reads similar to portions of his "Dental Prosthetics," but is more elaborate and contains additional material.

The subject of swaged metallic plates is presented in considerable detail and with many useful and practical hints regarding their successful construction, and the chapter on continuous gum dentures is by D. O. M. Le Cron and contains the usual technique.

Artificial crowns and bridge work are two chapters by H. H. Burchard and Fred A. Peeso in conjunction. The extirpation of vital pulps by driving a point of orange wood into the roots may be worthy of historical notice, but hardly seems of enough value in these days to devote a whole page to its description. Under the treatment of purulent pulp conditions, "meditrina," whatever that may be, is recommended, but the well recognized formo-cresol and other drugs receive no mention. The methods for construction of crowns and bridges are the old standbys and little is said relative to the many possibilities afforded by casting. Likewise, no mention is made of the replaceable facings such as Steele's and Goslee's. These chapters seem the least complete of all.

There is a chapter devoted to the hygienic relations and care of artificial dentures which is worthy of careful reading.

Palatal mechanism is by R. Ottolengui and is quite completely done by one who should be able to speak with authority.

The general outlines of this book and its methods of presenting the several departments of the subject matter remain essentially the same as in the previous editions. It has been written primarily for the dental student and hence is simple and direct, yet with considerable detail. The illustrations are ample and excellent.

For one who wishes to have a good knowledge of pros-

thetic denistry this book is certainly complete and up-to-date.

Dental Electro-therapeutics. By Ernest Sturridge, L.D.S., Eng., D.D.S., Fellow of the Royal Society of Medicine, Member of the British Dental Association, London, Eng. 12mo, 318 pages, with 154 engravings. Cloth, $2.75 net. Lea & Febiger, Philadelphia and New York, 1914.

Electricity and its application as a therapeutic agent in the field of dentistry has, in general, received but scant attention. It is only in the last few years that the great value of the X-rays have been fully appreciated by the profession at large. The enlightenment along electrical lines has perhaps been slow, due to the lack of adequate literature pertaining to the subject.

The author in his preface states that he feels that the great majority of dentists, not only do not know the technique necessary for elecro-therapeutics, but on the whole are lacking in the fundamental knowledge of electrical physics. For this reason he has divided his treatise into two distinct parts.

The first section, dealing with electro-physics, begins with the simplest forms of electrical phenomena, and in the eight chapters the reader is informed as to cells, dynamos, batteries, switchboards, motors, X-ray apparatus, etc.; with reference, continually, to the special dental uses of these things. The author is direct and concise and with reasonable study the novice could soon become tolerably familiar with the theoretical considerations. References are made to other and more elaborate books for those who may wish to get fuller details. The chapter upon X-rays or Röentgen rays concludes this section and gives the principles upon which these rays are used in the taking of pictures, and of diagnosis therefrom.

The second part of the book is devoted to electro-therapeutics and is primarily a practical presentation of the methods employed, and it goes into considerable detail relative to the technique to be used. Cataphoresis is discussed and the author feels that the effects produced and recorded, as the

obtunding of sensitive tooth structure, is not a cataphoretic effect, but one resulting from the ionization of the electrolyte upon the passage of the current.

Ionic medication is the principle laid down by the author for the treatment of pyorrhea, septic root canals, abscess conditions, and for anesthesia and bleaching.

Writing of pyorrhea, he is most emphatic in pointing out the necessity of first surgically removing all calcareous deposits upon the roots of teeth, stating: "It is absolutely a waste of time to attempt ionic treatment of pyorrhea alveolaris if any particles of calcareous deposit are left clinging to the roots of the teeth." He also feels "convinced of the local nature of pyorrhea."

The medicaments consist chiefly of zinc, copper, and iodine ions. His results are very interesting, and on the whole rather persuasive.

For anyone who wishes information upon the subject of dental electro-therapeutics this book should be ideal and it is to be hoped many will avail themselves of this opportunity, for the subject seems quite timely.

NOTICES

PANAMA-PACIFIC DENTAL CONGRESS

Panama-Pacific International Exposition to Convene in San Francisco in 1915

More than 3,000 dentists from every part of the civilized world now are expected to attend the Panama-Pacific Dental Congress to be held in San Francisco during the Panama-Pacific International Exposition, which will be open from February 20 to December, 1915, inclusive.

The Dental Congress, which is being promoted by prominent dentists of the Pacific Coast, promises to be the largest gathering of dentists ever held, and will be the motif for discussions and addresses on the latest advances in dentistry. The Congress will convene August 30, 1915, and will remain in session for ten days.

A feature of the Congress will be a great clinic, at which the latest methods of dental surgery, practiced in every country of the world, will be demonstrated. It is expected that dentists of international reputation will attend the Congress, and the discussions of the thousands of delegates will mark an epoch in the history of dentistry.

"Representatives of every country where dentistry is practiced will attend this Congress," said Dr. Frank L. Platt, of San Francisco, who is chairman of the local committee of organization. "It will be a thoroughly international gathering. Papers will be read on the most advanced subjects known to the profession, and many of the participants will be men of international reputation. The latest methods used by dentists in various countries will be demonstrated in a great clinic, where there will be from 25 to 50 chairs, and all kinds of dental operations will be performed for the benefit of the thousands of assembled dentists."

The Dental Congress will be financed by a corporation known as the Pacific Dental Congress Commission of 1915. Active work toward securing international representation is in the hands of a committee of organizations, representing the dentists in the Pacific Coast States. This committee consists of a director in each of the States of Idaho, Washington, Oregon, Utah, and Arizona, together with ten members of California. Dr. Platt is chairman of this committee, and Dr. Arthur M. Flood, also of San Francisco, is secretary. Other members are Dr. F. G. Baird, San Francisco; Dr. H. A. Fredrick, San Francisco; Dr. F. G. Jarvis, Oakland; Dr. Joseph Loran Pease, Oakland; Dr. H. G. Chappel, Oakland; Dr. R. B. Giffen, Sacramento; Dr. George F. Stiehl, Salt Lake City, Utah; Dr. B. M. Brookfield, Idaho Falls, Idaho; Dr. George T. Williams, Seattle, Wash.; Dr. Arthur W. Chance, Portland, Ore.; Dr. H. H. Wilson, Phœnix, Ariz.; Dr. Charles M. Benbrook, Los Angeles, and Dr. T. Sydney Smith, Palo Alto, Cal.

Pacific Coast dentists already have subscribed $13,000 for the pro-

motion of the Congress, and of this $7,000 has been collected to date. This money is being used in publicity work, and invitations to the Congress are being sent out broadcast over the world. Executive committees are being appointed in every country where a dental organization exists.

A striking feature of the Congress will be the exhibits by dental manufacturers and dealers, which will include modern apparatus and appliances. As the Congress will meet in the new Municipal Auditorium, this array of interesting exhibits will be housed in the same building during the sessions of the Congress. Two thousand front feet of space will be occupied by the exhibits.

While these exhibits will be on display only during the Congress, there will be an extensive array of dental exhibits throughout the exposition in the Palace of Liberal Arts, one of the eight main exhibit palaces. These will include apparatus and instruments used in dentistry, specimens of bridge and plate work, and the latest electrical devices used in dental surgery.

The modern application of electricity to dental uses, one of the most recent advances in dentistry, will receive important attention at the Dental Congress, and much of the latest apparatus on display will illustrate this subject.

Other advances made by dentists of every country will be considered, and especial attention will be given to scientific elimination of pain in dental work.

A number of national and State dental societies and fraternities will meet with the Panama-Pacific Dental Congress, instead of holding their individual annual meetings. Among those that already have signified their intention of meeting with the Congress are the National Dental Association and the American Society of Orthodontists.

SIXTH INTERNATIONAL DENTAL CONGRESS AT LONDON, AUGUST 3-8, 1914

The Committee on Transportation of the National Dental Association has completed arrangements with the International Mercantile Marine Company, comprising the American, Atlantic Transport, Leyland, Red Star, White Star, and White Star-Dominion lines, whose fleet includes such large, splendid and steady steamers as the "Olympic," "Oceanic," "Adriatic," "Baltic," "Cedric," "Celtic," "Lapland," "Minnewaska," "Minnehaha," "Minnetonka," "Minneapolis," "Laurentic" and "Megantic," sailing to and from numerous prominent ports in England and the Continent, and application for sailings and rates should be sent in at once.

Our delegates to the Congress will be allowed a reduction of 25 per cent. from tariff rates on all steamers of the International Mercantile Marine Company lines sailing on and after July 9 from American and to August 20 from Great Britain and Europe, with the single exception of

the "Olympic" August 19 from Southampton and Cherbourg for New York.

Please note that when the concession referred to would bring the price for passage below the minimum rate of the steamer selected, the lowest rate of that steamer will be charged as follows:

"Olympic," $130 to or from Plymouth, Cherbourg, and Southampton.

"Oceanic," $110 to or from Plymouth, Cherbourg, and Southampton.

"Adriatic," $110 to or from Queenstown and Liverpool.

"Baltic," "Cedric," and "Celtic," $100 from Queenstown and Liverpool.

"Lapland," $97.50 to or from Dover and Antwerp.

Other Red Star Line steamers $85 to or from Dover and Antwerp.

"Majestic," $95 to or from Plymouth, Cherbourg, and Southampton.

Atlantic Transport Line, $85 to or from London.

"Laurentic" and "Megantic," $92.50 between Montreal, Quebec, and Liverpool.

It is important, in order to obtain good accommodation, that delegates to the Congress should communicate at once regarding reservations with the International Mercantile Marine Company, 9 Broadway, New York City, stating the dates of their proposed outward and return sailings; also their requirements as to accommodations. Applications will be filled in the order of their receipt. A deposit of 25 per cent. of the eastbound passage money is required when the reservation is made, the balance for the round trip being payable at least three weeks prior to the outward sailing.

The committee will also reserve dining saloon seats, steamer chairs, and rugs, the deck chairs and rugs renting at $1 each for the voyage. Seats can also be reserved on the trains to London, for which the rates, first class, are as follows:

Via Southampton	$2.75
Via Plymouth	7.50
Via Liverpool	7.00
Via Dover	4.75

The committee also calls the attention of delegates to the Travelers' Checks issued by the International Mercantile Marine Company in denominations of $10, $20, $50, $100, and $500, which will be found the safest and most convenient way of carrying funds, as the checks are accepted by hotels, shops, banks, etc., throughout Great Britain and Europe. These are issued for their face value, plus one-half of 1 per cent. commission, and checks not used will be redeemed at face value. It will be to the advantage of the association for its members to use these checks.

As the White Star sailings available, for the Congress, from New York, are on July 9, 11, 16, and 18, arrangements have been made with the Holland American Line for those who wish to sail on Tuesday the

14th, to do so, on their steamer "New Amsterdam," on which the following rates have been secured:

They will allow a discount of 25 per cent. on the tariff rate for all rooms on Deck A (except the Chambres de Luxe), with the understanding that each room be occupied with three passengers.

On Decks B and C they will place all outside and inside rooms we require, at our disposal, at the minimum rate per berth, provided that each room be occupied by three passengers.

The passengers to be carried will be divided in proportion to the available accommodations on Decks A, B, and C.

Any communications concerning this boat should be sent to Mr. Nyland, Holland American Line, 21 State Street, New York City.

Herbert L. Wheeler, Committee.

560 Fifth Avenue, New York City.

THE 6TH INTERNATIONAL DENTAL CONGRESS

London, England, August 3-8, 1914.

The Sixth International Dental Congress will be held in London, England, August 3-8, 1914. The committee appointed by the National Dental Association, having in charge the affairs of the Congress relating to the United States of America, have selected the following to take part in the Congress programme:

Addresses.

Dr. H. J. Burkhart, Batavia, N. Y., to deliver the address on behalf of the National Dental Association at the opening session.

Dr. Edward C. Kirk, Philadelphia, Pa., address before the general session, the afternoon session of the opening day, "The Tendencies in Dental Education."

Reporters.

Section 1. Dental Anatomy, Histology, and Physiology.—"The Evolution of the Human Dentition," Dr. I. N. Bromell, Philadelphia, Pa.; "Calcification," Dr. A. R. Starr, New York City, N. Y.; "Chemistry and Physiology of Saliva," Dr. Edward C. Kirk, Philadelphia. Pa.

Section 2. Dental Pathology and Bacteriology.—"The Etiology of Dental Caries," Dr. B. Holly Smith, Baltimore, Md.; "The Etiology and Pathology of Pyorrhea Alveolaris," Dr. Percy R. Howe, Boston, Mass.; "Pathological Conditions of the Dental Pulp," Dr. R. W. Bunting, Ann Arbor, Mich.; "The Pathology of the Antrum," Dr. Chas. H. Oakman, Detroit, Mich.

Section 3. Dental Surgery and Therapeutics.—"Inflammatory Diseases of the Gingival Margin and Peridental Membrane (Pyorrhea Alveolaris)," Dr. T. Sidney Smith, Palo Alto, Cal.; "Restorations of Lost Portions of Tooth Substance by Inlaying," Dr. R. Ottolengui, New York City, N. Y.; "Oral Sepsis in Relation to General Disease," Dr. C. N. Johnson, Chicago, Ill.; "The Prevention of Oral Sepsis by Treatment," Dr. J. D. Patterson, Kansas City, Mo.

Section 4. Dental Physics, Radiography, and Metallurgy.—"The Uses and Advantages of X-Rays as an Aid to Diagnosis, Including the Differentiation of the Radiographic Appearances of Normal and Abnormal Tissue," Dr. Howard R. Raper, Indianapolis, Ind.; "The Structural and Other Changes Arising in Connection with Metals Used in the Mouth," Dr. Clarence J. Grieves, Baltimore, Md.; "The Theory and Practice of Pressure Casting," Dr. Weston A. Price, Cleveland, Ohio.

Section 5. Dental Prosthesis.—"Articulation and Articulators," Dr. J H. Prothero, Chicago, Ill.; "Design and Retention of Partial Dentures," Dr. H. J. Goslee, Chicago, Ill.

Section 7. Oral Surgery and Surgical Prosthesis.—"The Late Results of Cleft Palate Operations," Dr. Truman W. Brophy, Chicago, Ill.; "The Treatment of Dental and Dentigerous Cysts," Dr. Wm. Carr, New York City, N. Y.; "Surgical Prosthesis of the Jaws," Dr. M. C. Smith, Lynn, Mass.

Section 8. Anæsthesia. General and Local.—"Gas and Oxygen, Alone, in Mixture and in Sequence for the Extraction Operation," Dr. Chas. K. Teter, Cleveland, Ohio; "Gas and Oxygen Analgesia for Conservative Operations," Dr. Thos. B. Hartzell, Minneapolis, Minn.; "Local Anæsthesia With Special references to (*a*) Methods, (*b*) Drugs, (*c*) Sphere of Usefulness, (*d*) Contra-Indications, and Dangers," Dr. Eugene R. Warner, Denver, Col.

Section 9. Oral Hygiene, Public Instruction, and Public Dental Service.—"The Effects of Dental Treatment on National Health and Physique," Dr. Herbert L. Wheeler, New York City, N. Y.; "Prophylaxis at Different Ages," Dr. A. R. Melendy, Knoxville, Tenn.; "Lantern Demonstration of Slides Showing (*a*) Means of Affording Public Instruction in Dental Hygiene, e. g., Lecture Material, Charts, etc., (*b*) Photographs of School Dental Clinics, Institution for Public Dental Service for Adults or Other Institution in Which Public Dental Treatment is Being Carried Out," Dr. Wm. A. White, Phelps, N. Y.

Section 10. Dental Education.—"Methods of Teaching Orthodontics to Dental Students," Dr. S. H. Guilford, Philadelphia, Pa.

The following have been selected as Honorary Presidents of the Sections:

Section I. Dental Anatomy, Histology, and Physiology, Dr. Matthew H. Cryer, Philadelphia, Pa.

Section II. Dental Pathology and Bacteriology, Dr. Thos. B. Hartzell, Minneapolis, Minn.

Section III. Dental Surgery and Therapeutics, Dr. Edward S. Gaylord, New Haven, Conn.

Section IV. Dental Physics, Radiography, and Metallurgy, Dr. J. P. Buckley, Chicago, Ill.

Section V. Dental Prosthesis, Dr. D. O. M. Le Cron, London, England.

Section VI. Orthodontics, Dr. Roscoe A. Day, San Francisco, Cal.

Section VII. Oral Surgery and Surgical Prosthesis, Dr. J. D. Patterson, Kansas City, Mo.

Section VIII. Anæsthesia. General and Local, Dr. Thos. P. Hinman, Atlanta, Ga.

Section IX. Oral Hygiene, Public Instruction, and Public Dental Services, Dr. Herbert L. Wheeler, New York City, N. Y.:

Section X. Dental Education, Dr. Henry W. Morgan, Nashville, Tenn.

A list of essayists and clinicians will be published later.

The committee invite the ethical members of the profession of the United States of America to become members of the Congress. Membership, which includes admission to the Congress sessions and a copy of the proceedings is $7.50, and for members of their families accompanying them $3.75.

Dr. Herbert L. Wheeler, 560 Fifth Avenue, New York City, has been appointed by the committee to arrange for steamship rates, sailing dates, itinerary, etc. Those desiring to attend the Congress, sailing with the American delegation immediately following the meeting of the National Dental Association, Rochester, N. Y., July 10, 1914, are requested to correspond with Dr. Wheeler.

TRUMAN W. BROPHY, Chairman,
WM. CARR,
S. H. GUILFORD,
WALDO E. BOARDMAN.
Committee.

BURTON LEE THORPE, Secretary, 3605 Lindell Boulevard, St. Louis, Mo.

NEW JERSEY STATE DENTAL SOCIETY

The forty-fourth annual convention of the New Jersey State Dental Society will be held at the North End Hotel, Ocean Grove, N. J., July 15, 16, 17, and 18, 1914.

The hotel is situated on the ocean front, at the foot of Wesley Lake. It is within a few feet of the Asbury Park Casino and within a block

of the Asbury Park trolley. The meetings will be held in the hotel, while the entire second floor of the pavilion will be devoted to the clinics and exhibits. This pavilion is over the ocean with plenty of light and every chance for the cool sea breezes to blow through. A bridge over the boardwalk connects the hotel and pavilion so that it makes an ideal arrangement for a convention.

An attractive meeting is being arranged and a cordial invitation to attend is extended to all ethical dentists.

JOHN C. FORSYTH, Secretary.

COMPLIMENTARY DINNER TO PROFESSOR FANEUIL D. WEISSE

A complimentary dinner to Faneuil D. Weisse, M.D., will be tendered by his friends in the medical and dental professions, to commemorate his completion of fifty years as practitioner and teacher, at the Hotel Astor, Forty-fifth Street and Broadway, Saturday evening, March 28, 1914, at 7 o'clock.

Those desiring to attend will kindly communicate with the secretary at as early a date as possible.

HENRY SAGE DUNNING, *Secretary*,
17 East 38th Street, New York City.

COMMITTEE.

W. W. WALKER, *Chairman*, 58 West 50th Street, New York City.
H. S. DUNNING, *Secretary*, 17 East 38th Street, New York City.
J. W. TAYLOR, *Treasurer*, 106 East 57th Street, New York City.

H. W. GILLETT,	R. OTTOLENGUI,	H. P. GOULD,
A. R. STARR,	W. B. DUNNING,	G. B. PALMER,
A. L. SWIFT,	E. HILLYER,	F. W. VAN SAUN.

MASSACHUSETTS DENTAL SOCIETY

The fiftieth anniversary meeting of the Massachusetts Dental Society will be held on May 7, 8, and 9, 1914, at the Hotel Somerset, Boston, Mass.

A. H. ST. C. CHASE, Secretary.

EVERETT, MASS., January 26.

PENNSYLVANIA STATE DENTAL SOCIETY

The forty-sixth annual meeting of the Pennsylvania State Dental Society will be held at the Bellevue Stratford Hotel in Philadelphia on June 30, July 1, and 2, 1914.

LUTHER M. WEAVER, Secretary.

7103 Woodland Avenue, Philadelphia.

SUBJECT INDEX FOR MARCH, 1914

[Abbreviations: disc., discussion; rev., review; edt., editorial; ed., edition.]

THE JOURNAL

OF THE

ALLIED DENTAL SOCIETIES

VOL. IX JUNE, 1914 NO. 2

THE JOURNAL CONFERENCE

On Saturday, March 14, the annual Journal Conference of the Allied Dental Societies was held in Boston, Mass. The result was most gratifying to the many friends of THE JOURNAL who attended, as the day was a profitable one for the cause of Professional Journalism and most enjoyable for all concerned.

The delegation from New York, which included Drs. S. E. Davenport, W. B. Dunning, Karl C. Smith, Herbert L. Wheeler, C. Franklin MacDonald and S. E. Davenport, Jr., were entertained at the Art Club at breakfast. A pleasant morning was spent in going through the Forsyth Infirmary under the guidance of Mr. Forsyth and others of the trustees, and after a delightful automobile ride the entire party, augmented by others, returned to the Art Club for luncheon.

Following the conference in the afternoon, twenty-nine prominent men attended an informal dinner at the Thorndike Hotel. Dr. Piper made an exceedingly able toastmaster, and speeches were delivered by Drs. George A. Bates, Davenport, Sr., W. H. Potter, H. L. Wheeler, R. R. Andrews, W. B. Dunning and Eugene H. Smith. A lettergram from Dr. William Carr of New York, expressing his deep interest in " Independent Journalism " and his regret at his inability to be present, was also read by Dr. Davenport.

A point brought forward in the speeches that was deserving

of special note was the fact that THE JOURNAL is now worthy of the support of all ethical dentists, not only because it is a publication independent of supply house influence, but because of its real merit. The unfailing interest and sacrifice of the first supporters of such independence, men like J. Morgan Howe of New York, Louis Jack and James Truman of Philadelphia, R. R. Andrews of Cambridge and others, have therefore not been in vain, and their desire is being attained.

A brief report of the conference held in the afternoon, follows:

Dr. C. Edson Abbott was elected chairman of the meeting, with Dr. Davenport, Jr., secretary. Last year's report was read by the secretary and the treasurer's report was presented and accepted, showing that the financial condition was the best in the history of THE JOURNAL.

Dr. Davenport, Sr., pointed out that the list of paid subscribers, not members of the Allied Dental Societies, had materially increased during the past year and reported upon the cost of publication as borne by each society. It was suggested that every society appropriate a definite sum annually, instead of following the present method. Discussion.

Drs. Piper, Jameson and others reported that THE JOURNAL was meeting less opposition by Boston men and was gaining greatly in favor. Dr. Dunning referred to the new departments added recently, and said that further improvements would gradually be made. He assured those present that THE JOURNAL'S reputation was growing and that the quality of the material in its pages was of a higher class than formerly.

The advertising situation was presented by Dr. Davenport, Jr. He urged that, because of the lack of paid agents to solicit advertisements, that every man should interest himself and accomplish something personally.

Short speeches by Drs. MacDonald, Rice, Proctor, Warner,

Richburg, Abbott, Mackay and Potter followed. Drs. Karl Smith and Wheeler expressed themselves as favoring an increase in the subscription list of THE JOURNAL, and as one method of doing this, Dr. Wheeler suggested that other societies should be interested to the extent of joining the Allied Dental Societies and publishing their proceedings in THE JOURNAL.

It was moved by Dr. Proctor that a committee be appointed to take up this matter. Motion carried.

The following officers were reelected for the year 1914:

Editor-in-chief, Dr. Wm. B. Dunning.

Associate editor, Dr. S. E. Davenport, Jr.

Secretary and treasurer, Dr. Karl C. Smith.

Dr. A. G. Richburg was appointed by the Chair to assist Dr. Davenport, Jr., in managing the advertising department. Meeting adjourned.

The arrangements for the entertainment of the New York delegation were perfect and everyone of this small band was deeply appreciative of the courtesies bestowed upon him.

Altogether, the conference was the best ever held, as the reports from all sides indicated increasing interest and support of our publication by the rank and file. All were of the opinion that THE JOURNAL is fast becoming indispensable to many men throughout the country.

Respectfully submitted,

S. E. DAVENPORT, JR., *Secretary*.

SECONDARY INFECTIONS HAVING THEIR PRIMARY ORIGIN IN THE ORAL CAVITY[1]

By Dr. Thomas B. Hartzell, Minneapolis, Minn.

Gentlemen of New York, your president will bear testimony to the fact that I did the best I could to avoid inflicting myself upon you the third time within a twelvemonth. Therefore, upon him must lie the blame for your present affliction. We are, most of us, so obsessed with our own interests and overwhelmed with our own concerns that we gradually get out of touch with the universe. There is no doubt but that we need to get out of our little orbits and establish points of contact with other lives. Perhaps that is the reason why I have come to New York again. From these visits I gain so much of value, of inspiration and appreciation of the work of others that it compensates me, and perhaps affords me my best excuse for again addressing you.

My subject, as you see, is one of large proportions. Just how large and how important it is does not now appear. From day to day and from month to month its important relationships multiply. When I was with you last fall, I made the statement that dentistry was on the threshold of a new era, and that its importance to human life and welfare must of necessity become of far greater moment than hitherto has been appreciated. To-day we have met here together in that new era of which I spoke. The reorganization of our National Society, with its growth and far-reaching influence, is binding us together in a common bond of interest for the betterment of society and ourselves. Moreover, it will teach us that we are elbow to elbow in a democracy the foundations of which are laid in the hearts of men and the purpose of which is to rear a structure which shall endure for all time; its motto shall be, one for all and all for one. By this means we shall have every fact which science can secure, placed at the disposal of each and every one of us, to become a potential factor in alleviating human suffering.

Preventive medicine is the goal of the medical and dental

[1] Read before the First District Dental Society, S. N. Y., Feb. 2, 1914. See disc., p. 250.

world to-day, and preventive medicine has done and is doing more to lengthen the span of human life than any other single factor in the world's progress. The empirical discovery of Jenner for the prevention of smallpox, and its immediate application by Napoleon for the protection of fifty thousand French troops, instantly impressed its value upon the world and forthwith inspired men to undertake new lines of scientific endeavor.

Beginning with Pasteur's wonderful research,—a research undertaken to save property values, namely, the silk, grape and life stock industries of France, which were tottering in the balance and seemed likely to be ruined, but finally resulting in the application of the principles evolved by him to the saving of human life through the knowledge of infections opened up to the world of science by that research,—the human race stands to-day master of the dread scourges, bubonic plague, yellow fever, typhoid fever, diphtheria, the prevention of tuberculosis, pneumonia, and many other preventable diseases. We now believe that the destructive pathologic conditions are due to the entrance into the animal economy of living organisms, the growth of which results in various types of inflammatory reactions which either destroy the tissue in which these organisms lodge, or so alter their metabolic processes that the vitality of the individual is reduced or destroyed. The great work in preventive medicine has been to discover these various families of pathogenic bacteria, disclose their origin, trace their entrance, and follow their metabolic processes in human or animal tissues. It necessarily follows that those who are interested in lengthening the span of human life revere the names of our great research workers and pathologists, placing them first on the scroll of remembrance in the world's history. For we all know that the brittle thread of life is easily broken; that to become a destructive genius—a Napoleon—is nothing compared to becoming the individual who can cause two blades of grass to grow where but one grew before. To my way of thinking, a Flexner or a Rosenow placed in the balance with a Napoleon would toss that great general into infinite space.

Preventive medicine, however, has reached a pause. With painstaking care it has studied the whole human economy ex-

cept the human mouth. Perhaps the reason for this lies in the fact that the dentist is jealous of his domain and the doctor equally jealous of his. Therefore, they have been content each to leave the other undisturbed, failing to appreciate the fact that their interests are common and that the work of both are indissolubly linked together. The great infections that can enter the body through the skin are now fairly well known. The infections that gain access to the circulation through the genital organs have been recognized and the methods for preventing their entrance into the tissues made evident. The air-born infections have been and are now being studied with great care. Water and food-born infections have been mastered, and the medical world now turns to a careful scrutiny of the human mouth for explanation of several types of infectious disease, the prevention of which has hitherto been impossible. Wherever an open lesion obtains, the possibility of infection is readily surmised. Wherever conditions for bacterial incubation exists, our bacteriologists and pathologists have given heed, and in many instances have unlocked doors that will free from pain and suffering many more of that throng whose days are passed in misery and whose nights are watered in tears.

Nearer and nearer to the dental field this line of research has approached. Our rhinologists have conducted a series of investigations of the sinuses, antral, ethmoid and frontal. Our pathologists have studied the character of bacterial flora possible on the mucous membrane of the nares and its accessory sinuses. As early as 1887, Alfred Mentel, of England, pointed out the relationship between the tonsil and rheumatic fever. A closer study of the tonsil as the path of entrance to infection was made by Pointon and Payne. More recently still, Billings and Rosenow have given us the analysis of their work upon the tonsil, which proves conclusively that the tonsil is a path of entrance to the blood stream for that small but wonderful organism, the streptococcus, whose possibilities for disease, dimly understood in the past, but more perfectly now, looms large for a still greater stride in preventive medicine.

Nearer and nearer to the dentist's chosen field of activity these researchers have approached. In the meantime what has

dentistry done in mouth research to keep pace with preventive medicine; the mouth, which presents the most perfect cultural conditions for most forms of pathogenic bacteria? To answer that question, one is compelled to say that dentistry has directed its efforts toward a study of the pathologic condition which destroys the dental organ itself, rather than toward a study of the pathogenic possibilities of mouth-planted and mouth-grown infections in their relationship to the balance of the human economy. It is true we have had our great men, the greatest of whom, in the study of bacteriology of the mouth, was Miller; and we have had many men who have devoted more or less time to a study of those conditions which make for the loss of teeth. With this study, the dentist, and dentistry as a profession, seem to have regarded their responsibility as ended with a possible solution of two problems—to wit, cause and controls of caries and loss of the alveolar process. The dental profession has congratulated itself that its task is completed, whereas one of the greatest problems of all has been left untouched. I do not wish to minimize in the slightest degree the infinite importance of the caries to the human race. Could caries of the human teeth be blotted out, it would be an enormous step in the prevention of other diseases. To the great credit of dentistry be it said, that the best brains of the dental profession have made possible such exact methods in the treatment of the teeth themselves, both for preservation and reconstruction when lost, that many are inclined to feel that operative dentistry is a crystallized science to which little more of value can be added. Nevertheless, we find medicine and surgery saying through one of its greatest representatives, Charles Mayo, of Minnesota, that the next great step in preventive medicine must be made by dentistry, and asking the question, "Will dentistry make that step?" The foundation upon which dentistry may build and through which dentistry may contribute its further share in human happiness and well-being, must be laid by more thorough understanding of the pathogenic possibilities of mouth-grown micro-organisms and a broader apprehension of the relationships growing out of these mouth-grown infections for the whole body.

Within the past year the most wonderful stride forward in

dentistry and medicine together, along those particular lines, has been made by Rosenow. He seems to have proven beyond a shadow of doubt that of the commonest inhabitants of the mouth, streptococcus mucosus and viridans have wrapped within their small bodies enormous possibilities for grave pathogenic conditions affecting multitudes of people. As I said a moment ago, the recognition of pathogenic organisms, together with their habits of growth and their paths of infection (and I will add here), their possibilities of transmutation when transplanted from one animal organism to another, is the greatest problem of preventive medicine. Miller recognized and isolated fifty odd types of micro-organism in the human mouth.

I do not care to deal at length with any family of mouth-grown micro-organisms except the streptococcus. There are three-named types of streptococci found in the human mouth. There is one often called streptococcus salivarus, though it is probable that the organism called by this name is the streptococcus mucosus. We have also streptococcus viridans, which in culture grows green upon the solid media. We have also the diplococcus of pneumonia and the pus-forming staphylococci, and, according to Hansen of Christiania, we have the bacillus pyorrhea, and others which are worthy of special note. We have also—what is of supreme importance—the most cunningly devised paths of entrance for these bacteria or any other bacterial organism in the mouth, into the circulation.

It is my present purpose here to discuss, first, the cultural possibilities of these organisms and the principles underlying their transmutations, and then briefly to discuss their paths of entrance.

Since Pasteur's remarkable work on the immunization of cattle to anthrax, we have recognized the principles, that it is possible to exalt or attenuate the vitality of micro-organisms either by changing their cultural conditions, which means making it more difficult or more easy for the micro-organism to grow or develop upon either artificial culture media of known constituents, or by transplanting the organism from one animal to another, which is designated as animal passage. Granting these possibilities in a given organism, let us consider for a

moment what the mouth offers in the way of cultural conditions to encourage transmutation. Animal passage, for instance, is constantly going on between human beings—through the medium of inhaled dust, public drinking cups, the common use of mouth utensils, dental instruments, the somewhat universal habit of kissing, and the ingestion of foods which have been exposed to bacterial organisms of one kind or another. These bacteria, passing through the mouth, leave a trail of micro-organisms which, by reason of transplantation, have contributed to them opportunties for better or more energetic growth and consequent change of character. The presence or non-presence of oxygen wonderfully affects certain organisms. Streptococcus viridans growing on the surface of the mucous membrane may not have in oxygen the property of hemolyzing blood. Allow it to enter a tonsil crypt, where the air or oxygen is under less tension, or into the root canal of a devitalized tooth, or into a deep crevice around the tooth caused by dento-alveolitis or so-called pyorrhea, and you have provided exactly what is necessary to change that common organism of the mouth into a virulent hemolytic organism, capable of dissolving blood rapidly.

No more cunningly devised or favorable conditions can be imagined for the possibility of the most dangerous transmutations of bacteria from one type to another than the conditions found in the human mouth, and particularly the root canals of the dead teeth, or the narrow V-shaped crevices which occur on destruction of the alveolar process in alveolitis; because, as Rosenow has pointed out, change of oxygen tension may transmute an organism from a comparatively harmless non-hemolytic individual into one of actively hemolytic power, and his observation—"When hemolytic streptococci are grown under relatively low oxygen tension, their hemolytic power is maintained. When grown in pure oxygen, they lose this property gradually and become green, producing streptococcus viridans."[2] He further observes that "This fact would seem to explain why streptococcus viridans predominates on the surface of normal or only moderately diseased tonsils and other mucous membranes, when, at the same time, the crypts harbor hemolytic streptococci in predominating numbers."

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[2] *Transactions of the Chicago Pathological Society*, Vol. IX, No. 2, p. 63.

I desire to note in this connection the fact that streptococci in root canals are compelled to grow under almost anaerobic conditions, thus becoming actively hemolytic. I also desire you especially to note that the relative oxygen tension in a tonsil crypt which has a normal opening in the mucous membrane cannot possibly be lower than the deep, narrow lesions we find constantly occurring around the roots of teeth where dento-alveolitis and pyorrhea are present.

In the light of Rosenow's observation, I have paid especial attention to the character of streptococcus growth in pyorrhea pockets and dental abscesses, and my own observation is that they vary from active hemolysis to the non-hemolytic type just in proportion as the pocket is deep or the existing abscess without external opening. When the abscess or pocket freely communicates with the air, streptococci are most often non-hemolytic; when the culture is obtained from deep but active abscesses, the resultant organism is hemolytic. If, however, the abscess is of long standing and blind, the organisms found therein are apt to be non-hemolytic. The author believes, in this case, failure to hemolyse is due to the fact that such abscesses are usually well walled in by granulation and new connective tissue, and that their own metabolic products act to depress their vitality.

The most careful work done upon the streptococcus growth with which the author is acquainted is that of Rosenow. During a series of studies lasting over eleven years, the latter has shown that streptococci found in the mouth or tonsils can be made, under suitable conditions, to change into typical and encapsulated lanealate pneumococci, capable of causing rapid and virulent pneumocoxemia; or under other cultural conditions to produce organisms which determine in the joints, causing arthritis deformans; and under still different cultural conditions to produce streptococcus viridans, which is the common organism in heart-valve lesions, and under still other cultural conditions to become capable of causing ulcers of the stomach and bowels.

In animals, Dr. Rosenow has experimentally brought about heart lesions. Recovering his organism from the heart lesions and comparing it with the injected strain, he has in turn caused

ulcer of the stomach. Recovering his organism from the ulcer in the stomach and comparing it with the original strain, he has caused joint infections. Again he recovered his organism from the joint, and he has been able to produce typical pneumonia with an organism which originally was a harmless inhabitant of the mouth, and subsequently to recover from the diseased lung the original strain.

Larson, who subsequently died, in his brilliant work on the fusiform bacillus, isolated coincidentally both from the blood stream and from a lesion around human teeth of an individual, has been able to cause the fusibacillus to develop typical spirilli and again relapse into the fusiform bacillus, illustrating in an impressive way these possibilities of transmutation.

Hansen, in his work on pyorrhea, has been able to show that bacillus pyorrhea, when grown in conjunction with streptococci and staphylocci, is vastly more pathogenic in its possibilities than when grown alone. He has also been able to show that both streptococci and staphylococci are infinitely more destructive when grown in symbiosis with his bacillus. Hecton and Rosenow together have recently shown us that strains of streptococci are distinctly capable of causing agglutination of pneumococci, and that immune pneumococcic serum is capable of producing agglutination of streptococci. Thus we see that the dentist is in daily and intimate relations with the possibilities of preventing or inducing pneumonia, ulcèrs of the stomach, acute joint infections, and destructive lesions of the heart muscles and valves.

The streptococcus mucosus was first definitely described by Howard and Perkins [3] in 1901, and was subsequnetly carefully studied by Schottmüller,[4] who isolated it from cases of parametritis, peritonitis, meningitis, and phlebitis. The organism has since been described by many observers as the incitant of a variety of lesions and is an apparently harmless inhabitant of the normal mouth. Morphologically, though showing a marked tendency to form chains, on solid media it often appears in the diplococcus form. It is enclosed in an extensive capsule, which

[3] Howard and Perkins, *Jour. Med. Res.*, 1901, N. S., 1.
[4] Schottmuller, *Munch. Med. Woch.*, xxi, 1903.

appears with much regularity and persistence. Though very similar in appearance, therefore, to pneumococci, these bacteria do not appear in the typical lancet shape. Upon solid media they show a tendency to grow in transparent moist masses. The regularity with which this micro-organism ferments inulin medium, and its agglutinative characters, make it probable that it is more accurate to place it with the group of pneumococci than with that of streptococci.[5]

Hiss and Zinsser, page 364, record "the peculiar fact that pneumococci are agglutinated in high dilution by sera obtained by immunization with streptococcus mucosus, a fact which argues strongly in favor of classifying streptococcus mucosus more intimately with the pneumococci than with the streptococci of the pyogenes group."

"The work of Aronson,[6] Marmorek,[7] and others, has shown that streptococcus immune sera, produced with any one race of pyogenic streptococci, exerted considerable, though variable, protective action against many other strains of streptococci. The same authors, as well as many others, working with the agglutination reaction, have shown that the agglutinins produced with one streptococcus strain were active against many other streptococci, while most active usually against the particular micro-organism with which they were produced. The immune reactions, therefore, seem to indicate a very close relationship between streptococci as a class."

If Schottmüller is able to find streptococcus mucosus in parametritis, peritonitis, meningitis, and phlebitis, and Rosenow can at will produce ulcers of the stomach, joint infections, heart lesions, and pneumonia with organisms found in the normal mouth, transmuting these according to conditions into other agents of systemic disease, does it not behoove us to study in our special field to close the paths of infection to these organisms?

The reasons for studying these paths of infection do not cease with the consideration of the lesions above enumerated. The author has now under observation a case of secondary kidney infection in which the blood pressure rose to considerably

[5] Hiss, *Jour. Exp. Med.*, 1905; Buerger, *Cent. f. Bakt.*, I, xli, 1906.
[6] Aronson, *Berl. klin. Woch.*, 1902; ibid., 1903.
[7] Marmorek, *Berl. klin. Woch.*, 1902.

over two hundred millimeters of mercury, an infection in which casts were found in great numbers in the urine and in which the urine furthermore contained albumin. In this particular case, the presence in the mouth of both alveolo-dental abscesses and pyorrhea pockets gave rise to the thought in the mind of the author that possibly the kidney condition and blood pressure condition before referred to were not the result of grave pathologic change in the kidney itself, but were rather a secondary slow poisoning by the metabolic products of streptococci absorbed through these large lesions in the mouth. The author's guess proved to be correct. For upon elimination of the active foci of infection in the mouth, the blood pressure fell to one hundred and fifty, albumin disappeared from the urine, and casts have become so reduced in number as to be difficult to find, whereas in the first examination they were exceedingly numerous. There is no question in the mind of the author that the toxic effects of the poisons, created by the metabolic processes of bacteria forced into the circulation, act directly in the tissues of the kidney, causing irritation and inflammation of the tissue and altering its function. This is more readily apprehended when you recollect that, in addition to osmosis occurring from the pockets and abscesses, we have the enormous force of occlusion to hasten the exchange of fluids between the lesion and the circulation. The pressure of occlusion acts as a piston pump against the periapical abscess and the lesion around the root, applying, by a pump-like action, thousands of pounds in the course of twenty-four hours, thus hastening ordinary absorption.

That these streptococcal infections, as well as any other type of infection which gains access to the pyorrhea pocket or root canal, are certainly found in the center of the body of the bone of the jaws, has been proven to be true in recent bacteriological studies made in our own laboratories, the material for which studies was obtained by clipping the root ends of extracted teeth directly into sterile culture media. These root ends were obtained in the following manner: First, thoroughly cleansing the whole mouth; second, drying the exposed tooth ends and crowns; third, bathing the crowns and exposed roots with heavy tincture

of iodine; fourth, thrusting an actual cautery into the tissue around the neck of the tooth from which all salivary moisture had been previously excluded; and fifth, extracting and instantly clipping the excised tips into the media.

These studies were primarily undertaken to explain the path of infection in eight cases of arthritis deformans in which the source of infection could not be determined; the tonsil, genito-urinary tract, alimentary tract, and accessory sinuses having been one by one eliminated. Without exception, every one of these eight cases has yielded streptococci, which on introduction into rabbits and guinea pigs destroyed the life of the animal too quickly to be of value in producing joint lesions, owing to the author's ignorance of the proper dose. That these infections were abnormal, is now found by the examination of an equal number of apparently healthy root ends by the same process, in which studies thus far no infections have been found, compelling us to the conclusion that these organisms were introduced through the open path afforded by careless root canal fillings and pyorrhea pockets.

The author further believes that the toxins and living bacteria which pass to the stomach are not infrequently responsible for the failure of the secretion of hydrochloric acid, because on cessation of the active supply of large amounts of bacteria, hydrochloric acid has again been observed in the stomach, and the long present failure on the part of the stomach to digest has gradually given place to a fairly normal digestive process unaided by recourse to the exhibition of hydrochloric acid or other digestents. The author further believes that the constant absorption of organisms growing in lesions about the teeth and on the tooth's surfaces themselves are responsible to a greater extent for malnutrition and chronic dyspepsia than any other single cause.

This belief is fortified through the observation of some hundreds of cases in which improved digestive conditions have promptly followed on the partial elimination of mouth infections. The author has recently noted entire recovery from bleeding ulcers of the stomach in two cases where obstinate pyorrheas were finally stamped out. In the light of the won-

derful work just made public in an article on the production of ulcer of the stomach by injection of streptococci by E. C. Rosenow in volume LXI, No. 22 of the American Medical Journal, the clinical experience observed in these two cases in which streptococcal conditions existed and were eliminated takes on added significance.

In order more clearly to appreciate the ease and directness of inoculation from these chronic lesions in the mouth, the author desires to present a series of lantern slides tracing the path of infection from tooth root ends and pyorrhea pockets into the circulation of the blood and lymphatic systems.

Conclusions.

Let us now summarize what we have been discussing. First, the mouth is the constant habitat of many destructive organisms and offers the best culture media possible for their growth; second, animal passage or the passage of an organism from one living being to another keeps these organisms in a constant state of change, exalting or depressing their pathogenic possibilities, dependent upon whether the living being to which they are transferred is relatively highly immune or has no immunity; third, animal passage is being made by these pathogenic bacteria. They gain entrance into the mouth by the following means: the inhalation of the dust of the streets and living rooms, foods, fruits, drinks (milk and water), finger tips, kissing, use of common drinking cups, etc.; fourth, the constantly changing reactions of the mouth from alkaline to acid favors transmutation as well as animal passage, in that it inspires exalted activity on the part of the organism; fifth, oxygen tension is always reduced just in proportion as the organisms find their way into root canals and pyorrhea pockets, thus making possible changes in organisms which induce them to attack one tissue or another; sixth, clinical observation is responsible for the belief that almost every individual who reaches manhood or womanhood has one or more blind alveolo-dental abscesses to his or her credit, and that these abscesses and pockets contain streptococci among other organisms; seventh, ninety per cent of the whole body politic presents lesions which range all the way from a mild gingivitis

to deep blind pyorrhea pockets around their teeth; eighth, tooth root surface in pyorrhea pockets is always more or less coated with living micro-organisms constantly ready to make incursions either into pulp chambers or into the tissue surrounding the roots, where entry into the circulation is rapid, easy and constant; ninth, it is the constancy of the supply which eventually breaks down immunity.

CASE HISTORIES

Case Record No. 1. January 20, 1914. History of B.

Family history, negative; personal history, typhoid fever in Germany; ill nine weeks, poor recovery, never having felt well since; complains of malaise; scarlatina in ninth year; appendicitis in 1902 and was operated on.

The patient was examined by an oculist previous to dental treatment December 28, 1912. There was an ocular defect of half of a diopter. Lenses were fitted.

The author began treatment January 18, 1913, and treated two teeth. Subsequent treatments were given January 20, January 22, treating right upper four and five; January 27, left upper six, seven and eight, finishing the upper arch February 3, treating left lower one, two and three and right lower one, two, three and four. On March 7 the author broke down at one sitting the granulating wall of the whole lower arch, finishing the treatment, planing all the roots and curetting the alveolar process edge.

On March 14, about the middle of the forenoon, the patient had a chill, caused by slight rise of temperature, and a general feeling of malaise and muscular pain. The following day there was a soreness in all the joints of the body, especially marked in both knees; headache and sore throat, mild. These symptoms continued with slight moderation for seven or eight days, when there was a gradual subsidence of all symptoms. The joint symptoms were very distinct and there was a marked sensitiveness in the knee joints upon the pressure of ordinary walking or standing. The same sensitiveness to a less degree was present in the shoulders and elbows. These are symptoms which he has never experienced before in any attack of the so-called La Grippe. After treatment, patient neglected to wear his lenses, but did not have any recurrence of headaches. Prior to this time his symptoms have been essentially the following: a tendency to tire easily after moderate exercise; rather marked constipation; recurrent albumin-uria (very mild), hyaline casts; frequent headaches, varying from a mild dull ache to a most severe attack. Patient is greatly improved in health and this history illustrates possibility of secondary general infection in a marked way.

CASE RECORD NO. 2. JANUARY 19, 1914. HISTORY OF MRS. M. L. R.

Age 37; family history, negative; personal history, negative. No illness prior to the year 1908, when patient was examined and treated for appendicitis by Dr. Hugh Fenton, of London, England. The appendix was not removed at that time, though abdomen was opened. The patient slowly recovered and was back in ordinary health at the end of one year. Two years after she had a second attack of appendicitis and was operated by Dr. James E. Moore, of Minneapolis, who removed a necrotic appendix and ovary on the same side. The colon had sagged and adhered to the bladder for a space of two inches. The patient was septic when she went on the table. Following the operation, bowels moved normally on the fourth day. About two months after the operation the patient first noted joint infection in the hands, stiffness and swelling of the finger joints and in the biceps of both arms. Intercostal neuralgia appeared and shoulders and joints became stiff and tender. Since 1910 the patient has been more or less affected, and since that time has had periods when work was exceedingly painful and distressing, though the patient has compelled herself to follow her vocation, that of a masseuse, treating eight or nine patients a day, but with a marked suffering for herself.

Patient appeared for examination and treatment November 24, 1913. An acutely abscessed tooth was found and all the teeth were tender, the gums sore, and discharging pus. The abscessed tooth was removed and the mouth put under treatment for the infection. On the fifth day following the extraction of the abscessed tooth the patient noted a marked improvement, and, as the treatment of pyorrhea moved forward, improvement of the joint inflammation steadily kept pace. The extreme weariness and malaise have given place to a markedly energetic and vigorous condition of the body. The finger joints which were swollen are to-day almost normal and not at all painful on movement. The patient can flex the hands vigorously without the slightest twinge, though when first examined the patient could not by any possible means flex the fingers into the palms of her hands. No vaccine or other treatment has been used in this case except to obliterate the foci which were producing the infection.

CASE RECORD NO. 3. JANUARY 21, 1914. HISTORY OF MRS. J.

Age 55; family history, good; personal history, negative until four years ago, when she first noticed slight tenderness in the shoulder, elbow and finger joints of the right side, followed at a later date by tenderness and swelling of the knee joints and ankles. Patient was treated for rheumatism off and on during the following three years. In the winter of 1913 she appeared for treatment. Careful examination was made and a deep abscess over the left upper lateral was discovered, which on incision was found to be one and one half inches deep, extending back in the superior maxillary bone, but not opening into the antrum or nasal

floor. It was a narrow, deep cavity. Abscesses were found on a right upper bicuspid root and right lower first molar. The evacuation of these abscesses and their subsequent healing was followed by a recession of all joint symptoms. The patient at this writing is perfectly well. A peculiar fact was noted in connection with this case. Whereas she had chronic constipation, necessitating the daily use of a cathartic, she now requires no cathartic, or, at most, very seldom has occasion for an aid in this direction.

Case Record No. 4. January 21, 1914. History of Mr. T.

Age 48; family history, excellent; personal history, negative. When first seen, chronic pain and tenderness in the masseter muscles of left side; tenderness of the sublingual glands and torticollis and pain in the left shoulder-joint.

Examination of the mouth revealed dead pulp in left lower third molar. Left lower first and second molars contained vital pulps and had pyorrhea pockets one-third of the depth of the root; general pyorrhea of all the molar and bicuspid teeth on both sides of the mouth; chronic dyspepsia, with constant eructation of gas after ingestion of food.

Extraction of the loose left lower third molar was followed by planing of the root surface of all the teeth affected by pyorrhea. After two weeks the rheumatic pains in the shoulder and tenderness of sublingual glands disappeared; digestion, improved; at the end of the fourth week all inflammatory symptoms contiguous to the teeth absent; teeth no longer tender on occlusion; patient has resumed vigorous mastication of food. After two months all symptoms of dyspepsia absent.

This case, by the way, is typical of a group of five cases in which mild joint involvements have been present from one to three years.

Case Record No. 5. January 21, 1914. History of Mr. A. P.

Age 24; family history of this case negative; personal history, excellent until May, 1912, when he had pain in the chest and fever and shortness of breath. He was aspirated and two quarts of fluid were drawn from the left thoracic cavity. This was followed by rapid recovery. In January, 1913, he had an attack of sore throat, followed with pain in the right knee, and then the other joints of the body became involved in rapid succession, pain in first one joint and then another. Joints became red and swollen and patient had some fever. Since that time the patient has been incapacitated for work and in the hospital nine months. When first seen by the author there was a marked swelling of the knee joints and finger joints. While he was able to move about, movement was painful, and patient spent most of his time in bed. (Note in hospital record.) On August 5, 1913, patient not helped by present treatment. September 30, dental radiograph showed abscess condition in the roots and slight resorption of root ends of lower first and second molars. The

author extracted the first molar and took smears and made cultures from the bottom of the alveoli.

A Gram positive non-hemolytic streptococcus was isolated from the cultures made from the root ends, from which a vaccine was prepared, and the patient received an initial dose of twenty million on December 14. An immediate exacerbation of the joint inflammation was noticed, which lasted three or four days, and was followed by a marked improvement in the joint condition. A second dose of twenty-five million of this vaccine was administered December 17. This was followed by an increase in tenderness of all the joints, from which recovery did not begin until the seventh day, after which a material improvement was noted. The administration of this vaccine has been continued at intervals of from five to eight days. The last dose of vaccine administered was one hundred and eighty million, January 13, 1914. Patient is now able to raise his hands above his head, touch the back of his neck and comb his hair, which has hitherto been impossible. Patient was discharged from the hospital and is now able to walk about and is free from pain except on extreme exertion of the joints. He is now able to wear his shoes, which hitherto has been impossible on account of the swelling of his feet.

Whether or not this case will go on to ultimate recovery we do not know, but present indications point to ultimate recovery. March 8, recovery now complete.

Case Record No. 6. October 30, 1913. History of Mrs. M. B. Hospital No. 3732. October 1, 1913.

Female, 32 years of age, white, married, American; occupation, general housework; present weight, 87½ pounds; three years ago weighed 145 pounds; losing weight progressively. Menses began at fourteen. Regular every thirty days, flowing six days. No pain during the period. Pregnant three times. Three children, no sepsis.

Patient had chicken-pox as a child, no complications. Scarlet fever three years ago. Began having a stiffness in both knees. She had never noticed any swelling of them before, but they were somewhat troublesome when she walked up and down steps. About the same time she noticed that her hands began to swell. This swelling would be only of a day's standing and then would disappear, to reappear later. The swelling next appeared in the feet and was of the same shifting nature. The joints were tender and felt sore. The following spring she began having diarrhea, which was very profuse. Often she had five or six stools daily. She went to the hospital and after a course of quinine enemata was cured. She felt better for a month and then the trouble began again. The joints became involved again. Even those of the spine and jaw were affected. Fourteen months after her first visit in the hospital, they told her she had some poison in her system which was causing all the trouble. They thought it came from her tonsils. They removed the tonsils and

made a vaccine from organism found in them, but there was not apparent relief. Patient was, however, able to be up and around doing her work up to three months ago. Since that time she has been in bed, and has been unable to dress herself or handle herself.

Patient says at times she has chills and fever. At times the fingers become blue and then become perfectly white, as if they were frozen. At the present she has swelling of the joints throughout the body, chills and fever.

(11-9-13.)

No apparent benefit from past treatment. Patient has teeth radiographed, which reveal two or three dental abscesses.

(11-11-13. Hartzell.)

Extracted mesial root of lower left first molar. This tooth showed in the radiograph a good sized abscess sinus. Only one root was extracted to allow for a chance for further bacterial cultures in case of error in the first one. On the same date two molars were treated for pyorrhea. Condition not very deep at any point, but quite general around the teeth.

(11-18-13. Hartzell.)

Treated pyorrhea on 11-15. Extracted and curetted mesial root and socket of lower left first molar. Took bacterial cultures of root and pyorrhea pockets. This pyorrhea condition is one of inflammation only of gum margins and only slightly of alveolar process. It is due to calculus and lack of oral hygiene.

(12-16-13.)

Gums look pretty fair now, although there is still a line of red around, which indicates not perfect health. (Leonard.)

(12-23-13.)

Recovered from vaccine and feels pretty fair; as well as at any time since being here. (Leonard.)

(12-30-13.)

Recovered from vaccine and seems better than at any time since arrival in hospital. Wrist joints, which were immovable, are now freely movable. There is still considerable blueness and tension in skin over finger joints, but otherwise joints are better. The vaccines increase the soreness, stiffness and tension about the joints for two or three days, the fingers becoming quite blue and swollen, and she feels as if she had a little fever, but there is not much sickness.

(1-8-14.)

Joints are very much better. Very little reaction from vaccine this time, although staphylococcus portion was increased over tenfold.

(Leonard.)

(11-3-13.)

Wasserman-negative. (Dr. Larson.)

(Blood cultures taken 1-10 were negative.)

(1.) Smears from root-ends of tooth showed Gram positive spindle-shaped bacilli; a few Gram positive cocci and a few very short Gram positive bacilli.

(11-18-13.)

Smears from pyorrhea pockets gave very small Gram positive bacilli and Gram positive cocci; fusiform bacilli and other Gram negative bacilli.

(11-18-13.)

No. 5 shows streptococcus. Streptococcus is occasionally seen in the other cultures. Later No. 2 showed Gram negative cocci, large Gram positive diplococcus and a small Gram positive cocci. (Signed, Gaskell.)

(2-1-14.)

Patient increased in weight 3½ pounds and has regained use of hand and is now able to walk again. (Hartzell.)

Case Record No. 7. January 21, 1914. History of Mr. P.

Age 58; family history, negative; past history, negative. He was in the best of health until October 8, 1912, on which date he was exposed to cold on an evening drive, which was followed by a chill and temperature of 103. The morning of the next day temperature was sub-normal; soreness and tenderness in the lumbar vertebra and a stiffness of the right shoulder, elbow and finger joints, with a temperature of 103 in the afternoon. This was followed by tenderness and enlargement of the right sacro-iliac joint. The inflammation in the lumbar region became very acute, so that coughing caused excruciating pain. These conditions continued with slight variation and loss of strength, until seen by the author the third week of January. Dental radiographs were made, which betrayed abscess of a right lower second molar, abscess of a left upper incisor, and deep pyorrhea pockets about many of the other teeth. The abscessed molar was extracted, the abscess in the central was treated with iodine injection. The pyorrhea pockets in the upper jaw were curetted and roots of the teeth planed. A gradual improvement was noted, the patient becoming free from the constant pain in the lumbar region on the eleventh day after treatment was instituted.

Owing to the intended absence of the author from his work, the treatment for pyorrhea of the teeth in the lower mandible was hurried through on January 23, 1913. The author deemed this inadvisable, but owing to the fact that the patient was exceedingly anxious to have this treatment rapidly completed because of the apparent improvement noted, operation of cleansing the pyorrhea pockets and curetting the process was finished on that date. The operation necessitated disturbing the wall of granulation tissue about all the lower teeth; an area equivalent to about one and one-half square inches of granulation tissue was broken down. This was followed on the sixth day by a lobar pneumonia involving the right lung. The pneumonia ran a classical course and recovery was

complete. Patient was able to get out of bed in May and has since made a steady and uninterrupted improvement. At the present he weighs 190 pounds and is in excellent health. Though some stiffness of the joints remained until midsummer, the patient has been able to bend over to tie his shoes, pick up a small object from the floor, and has regained perfect control of his whole body.

The author believes the pneumonia was the result of overtreatment on January 23.

Case Record No. 8. January 22, 1914. History of Mr. S.

Patient appeared at the office on the recommendation of a friend who had recovered from a joint involvement as a result of treatment by the author. He was not suffering any joint disturbance, but gave a record of ulcer of the stomach, of two years' standing. Diagnosis was postulated from tenderness in the abdominal wall and coffee ground dejecta, which diagnosis was made by an exceedingly competent medical man. The patient's mouth was extremely septic, containing a number of abscessed teeth and many others with marked infection in the gums and alveolar process from which was discharging a copious flow of pus. The patient was markedly constipated and examination of the urine revealed albumin. Digestion was exceedingly imperfect and the ingestion of food was followed by the constant eructation of gas. The mouth was rapidly cleared of infection, abscessed teeth were removed, and those which had sufficient bone left about them were treated by planing the root surfaces and curetting the alveolar process margins around them. The patient grew rapidly better, and in less than two months all tenderness in the abdominal wall disappeared. At the end of six months the patient was able to eat corned-beef hash, cabbage, or anything else which he desired, and is at present much increased in weight, in rugged health, and capable of doing as much work as when he was thirty years of age. This is the second case of this type in which the same character of treatment was given and in which the same type of result has ensued.

Case Record No. 9. January 22, 1914. History of Mr. P. L.

Age 67; general health has been excellent; all functions normal except digestion, which was hampered by a lack of hydrochloric acid; at the present time troubled with indigestion, malaise, and a feeling of weariness. The physical picture presented by this patient suggested a nephritic involvement. A pyorrhea was present from all the gums and an abscess over the root tip of the left upper first bicuspid, about one-third of an inch in extent. Examination of the urine revealed albumin and casts. Stamping out of the mouth-infection resulted, in less than two weeks, in complete absence of albumin, and the casts dropped from thirty in the first specimen to two.

August 12, 1912, his general health improved, and there has been no

return of albumin in the urine. The author has on record over forty cases of this type, all showing greater or less kidney involvement, ranging from a trace of albumin to a considerable amount with casts.

In view of the fact that time does not permit, the author will not burden his hearers at length with the recitation of other case records which point out clearly the possibilities of mouth infection involving distant tissues of the body. He has on record five cases of septic endocarditis, all of which showed no other lesion in the body which could reasonably be assumed as the path of infection except abscessed teeth accompanied by pyorrhea. Two cases of recent date were found, one of which died in a septic condition, from whose blood was isolated the fusiform bacillus, which is still being propagated in the laboratory by Barron and Larson, of the medical department of the University of Minnesota, which organisms show the power of transmutation from a distinct fusiform organism into a spirillum and which has at times relapsed to the fusiform type.

Another case from which the author took a blood culture two hours before death was exceedingly septic. The mouth presented a terrible picture, the alveolar process being uncovered and necrotic from one third molar to the other in the lower mandible. Bone from the body of the mandible produced an actively hemolytic streptococcus which, so far as we are able to judge by cultural characteristics and morphologically, is exactly identical with a streptococcus isolated from the heart's blood. No other open path of infection was revealed in the post-mortem except the necrotic tissues around the teeth, although there was evidence of endocarditis, which must have occurred in an earlier attack.

THE REACTION OF THE SALIVA[1]

By Edward C. Kirk, D.D.S., Sc.D.

In Collaboration With

W. S. Crowell, B.S., Ch.E., and J. L. Appleton, Jr., B.S.

Ever since dental caries, dental erosion, and other disorders destructive of tooth structure have been the subject of more or less serious consideration and study, the probability that acids were somehow concerned in these processes has been generally recognized. Indeed, the indictment against acid substances as the principal agents concerned in these processes has been definitely confirmed by modern scientific research. Moreover, the character and origins of certain of the acids which exert a destructive action upon tooth structure has been clearly demonstrated, certainly in the case of dental caries, and I believe with almost equal certainty in the case of so-called chemical erosion of the teeth. The fact that these disorders were suspected to be of acid origin is a logical deduction from the fact that tooth structure undergoes disintegration by, and is soluble in a variety of acids; also that it is insoluble in alkalis, and does not undergo disintegration by any strength of alkali that can be tolerated by the buccal mucosa.

With these data, constituting as they do common knowledge in dentistry, it naturally followed that search should be made for the factors which might be regarded as protective against destruction of the teeth by acids. Attention naturally concentrated itself upon the reaction of the saliva as a means for detecting the presence or absence of acid agencies and investigation of its alkaline content as an index of its freedom from acid agencies, and therefore of its protective potency with respect to the destructive effect of acids upon the tooth structure.

That acids and alkalis ordinarily neutralize each other to form innocuous saline compounds; also that certain substances called indicators, the most commonly known of which is litmus,

[1] Read before the First District Dental Society of the State of New York, March 2, 1914. See disc., p. 268.

undergo color changes when brought into contact with acid and alkaline substances, respectively, is likewise common knowledge. Hence, it has been the usual practice to test the reaction of the saliva in suspected cases by means of litmus paper, and to attempt to determine by the effect of the saliva upon the color of the litmus so treated, the acidity, alkalinity, or neutrality of the saliva thus tested. Various experiences with the litmus test quickly brought forth the fact that as an indicator for precise work it was faulty, hence other substances of the indicator class were brought into requisition in order to determine the reaction of the saliva with greater precision, but as in the case of litmus,. a certain factor of error was found to be inherent in the use of all indicators where precise results were sought.

Among the peculiarities of the salivary reaction that were made evident from the use of litmus as an indicator, is the so-called amphoteric reaction noted in many salivas, that is to say, it was found that some salivas would cause blue litmus to turn red, and the same saliva would cause red litmus to turn blue, from which the conclusion has been deduced that in a saliva yielding the amphoteric reaction there existed at the same time free hydrogen ions and also free basic ions. Or otherwise stated, the saliva contained two substances of acid and basic properties respectively not capable of neutralizing each other, which confronts us with the deduction that the basicity or alkalinity of the saliva, to some degree at least, is dependent upon the presence of a substance or combination which renders it incapable of neutralizing the source of acidity with which it is associated.

The study of the reaction of the saliva, as determined by a variety of indicators, shows a large factor of error in connection with those tested—namely, litmus, methyl orange, congo red, phenolphthalein, and thymolphthalein, as shown by the accompanying table:

TABLE A

RESEARCH ON SALIVA INDICATORS

Procedure.

To show the unreliability of indicators in titrating weak acids and bases such as are present in saliva, some titrations were made of phosphoric acid with sodium hydroxide, using the following indicators:

Methyl Orange, Congo Red, Litmus, Phenolphthalein and Thymolphthalein.

Note 1.—Phosphoric acid was selected because of its undoubted occurrence as the various sodium salts in saliva. Its presence in saliva was absolutely proven by the following experiment: 5 gram samples of two salivas were digested with concentrated HNO_3 and baked until all organic matter was carbonized or destroyed. The residues were dissolved, filtered and the P_2O_5 determined in the filtrate.

Subject A,	caries susceptible	P_2O_5	0.022%
" B,	" immune	"	0.028%

Saliva collected by expectoration while chewing paraffin wax about three hours after breakfast.

Experimental Part.

(a) Standardization of H_3PO_4. Solution.

10 cc. solution yield	.3892 gm. $Mg_2P_2O_7$	equals	0.2482 gm.	P_2O_5
10 " " "	.3888 " "	"	0.2479 "	"
Average			0.2481 "	"
10 cc. N. H_3PO_4 should yield			0.2367 "	"

Normality equals $\frac{.2481}{2367}$ equals 1.0481

9.541 cc. H_3PO_4 solution equals 10 cc. N. H_3PO_4 solution.

(b) Standardization of NaOH solution.

10 cc. H_2SO_4 solution yield	0.1331 gm. $BaSo_4$		
10 " " " "	0.1336 " "		
Average	0.1334 " "	equals	0.05605 gm. H_2SO_4
10 " N/10 H_2SO_4 contains			0.0490 " "

H_2SO_4 equals .1144 Normal.

10 cc. NaOH " 8.80 cc. H_2SO_4 solution.

NaOH " .1007 Normal.

N/10 and N/100 H_3PO_4 were made up by properly diluting the above standard H_3PO_4 solution.

N/100 NaOH was made up by properly diluting the above standard NaOH solution.

(c) Titration.

(1) *Theoretical results.*

Case I.

10 cc. of NaOH solution would chemically neutralize 10 cc. of an equivalent H_3PO_4 solution if all three of the (H^+) ions were active, i.e., $H_3PO_4 > (H_3)^{+++}\ (PO_4)^{---}$

Case II.

10 cc. of NaOH solution would neutralize chemically 15 cc. of an equivalent H_3PO_4 solution if two of the (H^+) ions were active, i.e., $H_3PO_4 > (H_2)^{++}\ (HPO_4)^{--}$

Case III.

10 cc. of NaOH solution would chemically neutralize 30 cc. of an equivalent H_3PO_4 solution if one of the (H^+) ions were active, i.e., $H_3PO_4 > (H)^+ \ (H_2PO_4)^-$

Hence, in order for our titrations to be of any quantitative value our results should be 10 cc. N/10 NaOH is equivalent to either 10 cc., 15 cc. or 30 cc. N/10H_3PO_4.

(2) *Actual titrations with various indicators.*

(a) *Litmus.*

(1) 10 cc. N/100 NaOH equals 19.72 cc. N/100 H_3PO_4
(2) 10 " N/10 " " 165.35 " " "
equals 16.54 cc. N/10 H_3PO_4
(3) 100 cc. N/100 NaOH equals 10 cc. N/10 NaOH
equals 21.6 cc. N/10 H_3PO_4

End points in every case obtained after boiling off CO_2 and found to be very unsatisfactory.

(b) *Methyl Orange.*

10 cc. N/100 NaOH equals 31.06 cc. N/100 H_3PO_4
10 " N/10 " " 359.0 " N/100 " equals
35.9 cc. N/10 H_3PO_4.
100 " N/100 NaOH equals 30.72 cc. N/10 H_3PO_4

Solutions not boiled, since Methyl Orange is not sensitive to CO_2; end point very difficult to satisfactorily determine.

(c) *Congo Red.*

10 cc. N/100 NaOH equals 30.92 cc. N/100 H_3PO_4
10 " N/10 " " 344 " " equals
34.4 cc. N/10 H_3PO_4
100 " N/100 NaOH equals 10 cc. N/10 NaOH equals 30.20 cc.
N/10 H_3PO_4

Solution not boiled (see above)—end point fairly positive.

(d) *Phenolphthalein.*

10 cc. N/100 NaOH equals 17.34 cc. N/100 H_3PO_4
10 " N/10 " " 181.0 " " " equals
18.10 cc. N/10 H_3PO_4
100 " N/100 NaOH equals 10 cc. N/10 NaOH equals 15.80 cc.
15.80 cc. N/10 H_3PO_4

End point after boiling off CO_2 very sharp and satisfactory.

(e) *Thymolphthalein.*

10 cc. N/100 NaOH equals 11.92 cc. N/100 H_3PO_4
10 " N/10 " " 151.8 " N/100 " equals
15.18 cc. N/10 H_3PO_4
100 " N/100 NaOH equals 10 cc. N/10 NaOH equals 13.00 cc.
N/10 H_3PO_4

End point as above.

(d) *Conclusions.*

From a consideration of the above it will be seen that in no case is a sharp,

consistent end point obtained which is not affected by the concentration of the reacting solutions. With no indicator are the theoretical results obtained. Methyl Orange and Congo Red approach Case III. Litmus lies between Cases II and III, while Phenolphthalein and Thymolphthalein lie between Cases II and I.

It is evident that any determination of the acidity or alkalinity of a substance consisting largely of phosphates and complex amino acid combinations, even weaker in positive acidity than phosphoric acid, in which indicators are employed can never be absolute, and that results so obtained can not even be considered comparative unless an absolute uniformity of conditions is rigidly observed.

The basic ions upon which the alkalinity of the saliva depends are presumably derived from the inorganic salts which it contains. It has not, so far as I am aware, been determined by any investigator that the saliva ever contains a free alkali. Both chemical and micro-chemical analysis have, however, demonstrated that the principal and characteristic basic salts of the saliva are sodium phosphate and calcium phosphate, with a marked preponderance of the former over the latter. Furthermore, analysis has shown that the total inorganic solids of the saliva amount only to approximately 0.4 to 0.6 (Starling).

In order to determine the presence and amount of these phosphates in the saliva five gram samples of two salivas were digested with concentrated HNO_3, and baked until all organic matter was carbonized or destroyed. The residues were dissolved, filtered, and the P_2O_5 determined in the filtrate;

Subject A, Caries Susceptible, $P_2O_5 = 0.022\%$
Subject B, Caries Immune, $P_2O_5 = 0.028\%$

The saliva was collected by expectoration while chewing paraffin wax about three hours after breakfast.

The alkaline or basic ions in the salivas from which the foregoing determinations were made would have a neutralizing power at most equal to, in Case A, of .14 cc. or N/1000 H_2SO_4, and for B of .16 cc. of the same solution.

It is, theoretically, possible that some portion of the solid inorganic constituents of the saliva may have basic qualities, and would be, therefore, capable of in a degree neutralizing acid ions, but as the solid inorganic constituents normally vary from 0.4 to 0.6, the neutralizing power of the inorganic solids, even as-

suming that they were all basic would not materially increase the total neutralizing power of the saliva for acids.

In the study of the reaction of the saliva with respect to its acid or alkaline character, we may assume that its alkalinity is a factor of its composition, as the secretion is formed in the gland, and that its acidity is ordinarily a secondary or acquired condition which is not characteristic of the secretion as it is formed in the gland, but which has developed after the secretion has been poured into the mouth as a result of the fermentative activities of oral bacteria. The exception in which the secretion shows an acid reaction at the time of its discharge from the salivary ducts is in pathological cases, notably in Arthritism, where the saliva contains di-hydrogen sodium phosphate, which salt exhibits an acid reaction to indicators.

In view then of the extremely low alkalinity of the normal saliva considered in a quantitative sense as measured by the basic ions in average normal saliva, it becomes pertinent as well as interesting to inquire into the accuracy of the frequently reported high alkaline index of the saliva. It is especially important that the neutralizing power which the basic ions of the saliva represent, should be known with some fair degree of accuracy in order that we may determine to what degree or extent the actual alkalinity of the saliva can exert a protective effect against the destructive action of acids upon the hard dental structures. The figures herein given in connection with the two salivas, A and B, in which the acid neutralizing power is recorded in terms of standard sulfuric acid solution represents an alkalinity far below that ordinarily reported, and altogether out of accord with the recently published findings of Pickerill,[2] whose method of determining alkalinity of the saliva was by titration with $N/50\ H_2SO_4$, using weak methyl orange as an indicator. His figures for alkalinity are expressed in the number of cc. $N/50\ H_2SO_4$ required to bring the methyl orange to neutral point. The discrepancy between the index of alkalinity as determined in saliva by Pickerill and the alkalinity in the salivas of cases A and B here under discussion, becomes evident when it is seen that the basic ions in salivas A and B would have required only .0007 and

[2]Pickerill: Prevention of Dental Caries and Oral Sepsis. Table I, page 136.

.0008, respectively, of the standard N/50 H_2SO_4 solution of Pickerill to effect their complete neutralization. That the saliva exerts a protective action against acid corrosion or disintegration of tooth structure is a fact which is sufficiently well established by copious and careful observation and experiment, but that the protective power of the saliva against acid action on tooth structure is due to the neutralization of acids by the alkalinity or basicity of the saliva, is extremely problematical.

In 1897 Professor Pavlov,[3] of St. Petersburg, stated that "acids and alkalis, in marked distinction to all other chemical reagents, receive (induce a flow of) a saliva very rich in protein material. Their harmful effects on the buccal mucous membrane are thereby greatly reduced. That these measures are of use is shown by the fact that large quantities of 0.5 per cent. hydrochloric acid can be repeatedly poured into a dog's mouth without causing the least injury, whereas if the tongue be dipped in the same solution for a few minutes the epithelium peals off in a layer as if scalded."

In 1907 Dr. Joseph Head[4] presented the results of an investigation in which he showed that the saliva exerted a very marked inhibitory influence upon the corrosive action of various acids upon tooth structure, in connection with which he stated "there are many experiments that I have made showing the power of saliva to inhibit the action of acid, and yet where such acid action is inhibited the saliva may sometimes show violent acid reaction to litmus," and he also states, "that the saliva has decided powers of protecting the teeth from acid decalcification that can hardly be explained by its contained alkaline salts."

In the *Dental Cosmos* for July, 1910,[5] I expressed the opinion that the "protective action on the part of the saliva in the instances cited is, in all probability, due to the action of mucin, which if present in sufficient quantity clears the saliva of acid in the same way that the acid clears the saliva of mucin—i. e., by precipitation as an acid—mucin coagulum." In order to determine to what extent the protective action of the saliva against

[3] Pavlov: The Work of the Digestive Glands. American Translation, page 73.
[4] *Dental Cosmos*, Vol. XLIX, page 801.
[5] A Consideration of the Question of Susceptibility and Immunity to Dental Caries. *Dental Cosmos*, Vol. LII, page 729.

acids depends upon its contained basic ions, on the one hand, and is due to its mucin content on the other, it became necessary to devise a method by which the basic ion content of the saliva could be accurately determined apart from any modifying influence which the mucin factor might exert. The factor of error, inherent in indicators, necessitated their abandonment. The method adopted was an adaptation of the principle of the hydrogen electrode, the value of which depends upon the principle that when a substance is dipped into a solution of its ions there is an electric potential between the substance and the solution, depending upon the concentration of its ions in the solution. The form of apparatus employed was that devised by Dr. Joel H. Hildebrand.[6]

Without entering into a detailed description either of the technical details of the apparatus, or of the theoretical phases of the principle involved in its application, it is sufficient for our present purposes to state that by the use of the hydrogen electrode of Hildebrand it became easily possible to obtain quickly, and with precision, records of the acidity or basicity of the saliva registered in terms of electro-motive force, giving results which are accurate quantitatively, and thus furnishing the basis for definite comparison between salivas of varying composition.

The following table will exhibit the results of a number of titrations of salivary reaction by means of the hydrogen electrode, showing variation in the salivary reaction measured in terms of E. M. F., with an interpretation of the results as related to those obtained by the use of indicators:

TABLE B

No.	*Subject*
1	Man—about 22—good health—works inside—taken 3 hours after breakfast.
2	Porter—white—about 40—poor digestion—poor teeth—taken shortly after lunch.
3	Clerk—about 50—weak stomach—taken about 2 hours after breakfast.
4	Dental expert—about 40—constant smoker—fair health—taken 2 hours after breakfast.
5	Lab. assistant—about 22—good health—moderate smoker—taken 2 hours after breakfast.

[6] *Proceedings VIIIth International Congress of Applied Chemistry.* Vol. I, page 217.

6 Dental expert—about 40—non-smoker—good health—taken 2 hours after breakfast.

7 Manager—about 60—heavy smoker and chewer—fair general health—pyorrhea—sample as above.

8 Dental expert—about 35—slight indigestion—smoker—taken as above.

Table of Hydrogen ion indices of Saliva, showing their corresponding reactions with indicators and the amount of acid or alkali necessary to make them neutral.

Saliva No.	Hydrogen ion concentration	Reaction to indicators Table Cosmos 1911, p. 322	Neutralizing power in terms of N/100 acid or alkali.
1	1.32×10^{-8}	Rosolic acid, positive red	.00009 cc. N/100 H_2SO_4
2	2.48×10^{-6}	Sodium Alizarin sulfonate turned from brown to red	.00025 " " NaOH
3	3.81×10^{-7}	Rosolic acid—faint rose	.000038 " " "
4	2.14×10^{-8}	" " positive red	.000056 " " H_2SO_4
5	7.75×10^{-9}	Phenolphthalein—faint rose	.00016 " " "
6	3.17×10^{-8}	Rosolic acid—positive red	.000038 " " "
7	3.90×10^{-7}	" " faint rose	.000039 " " NaOH
8	6.45×10^{-7}	" " " "	.000065 " " "
9	2.53×10^{-9}	Phenolphthalein—faint rose	.00047 " " H_2SO_4

In order to compare the results obtained by the hydrogen electrode with those obtained by titration with standard acid solution, the following titrations were made and showed the discrepancies noted in Table C:

TABLE C

Effect of adding Saliva to 10 cc. of N/100 Phosphoric Acid

Alkalinity of Saliva used equals 4.74×10^{-6}. Normal by hydrogen electrode 1 cc. equals .00047 cc. N/100 H_2SO_4=.00024 cc. N/50 H_2SO_4.

Alkalinity by titration with N/50 H_2SO_4 using weak Methyl Orange as an indicator 1 cc.=.51 cc. N/50 H_2SO_4

cc. Saliva added	H^+ ion conc.	cc. N/100 NaOH to exactly neutralize 1 cc.	H^+ ion conc. after diluting theoretical	cc. N/100 NaOH to exactly neutralize	Remarks
0	3.03×10^{-8}	.303	....	....	
1	2.04×10^{-8}	.204	2.75×10^{-8}	.275	
2	$.95 \times 10^{-8}$	.095	2.53×10^{-8}	.253	ppt. commences to form.

The alkali content of the saliva, .00000474 normal, is negligible in comparison with the change in acid concentration caused by the dilution of the solution and can be neglected. It is evident from comparing the above results that saliva exerts a far greater neutralizing power than is indicated by its alkalinity, which can be explained by the fact that the mucin is capable of removing the acid from the solution by precipitation, this being borne out by the appearance of a white cloud in the solution on the addition of the second cc. of saliva.

It seems evident, therefore, that the index of alkalinity as determined by the method of Pickerill is, strictly speaking, not an index of alkalinity at all, but rather an index of the power of mucin to clear the saliva of its acid content by forming an acid-mucin coagulum, as suggested in my paper in 1910 already quoted.

The alkaline index of Pickerill appears to be open to further probability of error by reason of the extreme difficulty of determining the end point of the reaction owing to the unreliability of a weak solution of methyl orange as an indicator, which necessarily introduces the element of personal equation as a large factor of error in the observation.

The question of the nature of the neutralizing power of the saliva for acids is one which is not only interesting and important from a scientific point of view, but from a practical standpoint as well. From the observations herein reported as well as from those previously reported by Dr. Head, and recently by Dr. Russell W. Bunting,[7] it seems evident that the power which the saliva possesses to rid itself of acids, and incidentally to exert a protective function against acid destruction of tooth structure, is not in any large degree, if at all, dependent upon chemical neutralization of the acid by the contained basic ions of the saliva, but is rather dependent almost wholly upon the precipitation by the salivary mucin as an acid-mucin coagulum. If this conclusion should be warranted by the results of further investigation, then our views with reference to the so-called alkalinity of the saliva must undergo radical modification, and among other things certain of the deductions which have in a practical way been drawn from the conclusions of Pickerill will also require

[7] *Dental Cosmos*, Vol. LVI, page 285.

modification. Thus as the result of his studies, he says:[8] "We cannot but conclude from this that the use of alkaline dentifrices for the prevention of caries is wrong, is physiologically incorrect, unscientific, and empirical; and not only so, but also actually conducive to the inception and progress of disease, by decreasing the circulation and alkalinity of fluids in the mouth.

"The use of alkalies seems to be based upon a wrong conception. It is as though it were thought that lactic acid developed and accumulated in the mouth, remaining there for some hours or until next morning, when an overwhelmingly strong alkali is introduced to neutralize it; whereas, of course, as each molecule of lactic acid is formed, it searches for something wherewith to combine. Alkaline salts of the saliva will obviously most readily satisfy it, but should these not be available, then the calcium phosphates and carbonates of the enamel surface are utilized.

"It cannot be too clearly recognized that, by the use of alkalies, only those molecules of acid formed immediately previously can be neutralized, and also that the natural defensive forces of the mouth are thereby lowered for some considerable time afterward." But from such observations and laboratory studies as I have here reported, it would seem that lactic acid as a matter of fact does develop a coagulum in the mouth, remaining there until next morning when the "overwhelming alkalinity" of a dentifrice is properly introduced to neutralize it, and does neutralize it.

It would be interesting to know in this connection just what alkaline salts exist in the saliva that are capable of neutralizing any acid. The alkalinity of the saliva so far as I am aware is dependent upon the presence of phosphates which are alkaline to indicators, but I am unable to write any equation, and I have found no chemist who could do so, that will represent the neutralization of a free acid by a phosphate without such reaction coming out with an acid at the end. $Na_3PO_4 + HCl = HNa_2PO_4 + NaCl$. Although HNa_2PO_4 is in itself alkaline in reaction, does not change the chemical fact that it is as much an acid as HCl differing from it only in strength. If the so-called alkalinity of the saliva should eventually be found to mean merely

[8] Pickerill: Prevention of Dental Caries and Oral Sepsis, page 152.

the physical clearing of the saliva of its acid by means of a mucin coagulum, our problem with reference to the relative value of acid or alkaline dentifrices takes on a new and interesting aspect. Thus when an acid is introduced into the oral cavity, for example an acid dentifrice, it immediately stimulates, according to Pickerill, an excessive flow of so-called alkaline saliva.

Pavlov, as already quoted at the beginning of this paper, states that both acids and alkalies stimulate a flow of saliva " very rich in protein material "—i. e., a mucinous saliva, which in contact with an acid dentifrice is precipitated as an acid mucin coagulum, and which, if not removed by brushing or by neutralization with an alkali, adheres to the tooth surfaces, localizing after the manner of the plaque, an acid corrosive substance upon the teeth surfaces. Precisely the same action is noticeable in the mouths of arthritics, whose saliva contains sufficient acid sodium phosphate to precipitate the mucin upon the teeth, which in course of time brings about a destructive erosive action mainly about the necks of the teeth.

I am, therefore, unable in the light of the study here reported to agree with the conclusion of Pickerill that the use of an alkaline dentifrice " is wrong, is physiologically inaccurate, unscientific, and empirical," for it is my belief that with a clear understanding of the part which mucin plays as a protective agent in the saliva, and particularly with a better understanding of the extent to which the action of mucin has been recently regarded as a factor of alkalinity in the saliva, we shall ultimately find that Professor Pickerill's indictment applies not to alkaline, but to acid dentifrices.

Neither the important role played by the mucin content of the saliva, not only in its protective function against acid destruction of the teeth, but also in the formation of bacterial plaques in dental caries, nor the chemical relationships of mucin, appear to have been fully considered in Professor Pickerill's elaborate study of the saliva. He says:[9] " The association observed clinically between ropy saliva and acute caries in children may be due to one or a combination of all three causes: (1) It may be a special characteristic of chronic pain associated with a ' nervous '

[9] Pickerill: Prevention of Dental Caries and Oral Sepsis, page 183.

or mental effect; (2) it may be due to the original cause of the caries—i. e., a too liberal consumption of 'free' sugar; (3) it may result from a deficient alkalinity of the saliva. It may possibly be regarded as an effort by Nature to provide a material which, if precipitated, would undoubtedly protect painful surfaces against acid stimuli."

It is difficult to understand how a ropy—i. e., mucinous saliva may result from a deficiency of alkalinity when it is well known that a deficiency of basic or alkaline salts in the saliva would mean a corresponding deficiency in mucin, upon which ropiness of the saliva depends, the solubility of the mucin being dependent upon the presence of alkaline salts. The suggestion that the ropiness of the saliva may be regarded as an effort of nature to provide a material which if precipitated would undoubtedly protect painful surfaces against acid stimuli, seems to suggest that Nature in carrying on her destructive work of dental caries, graciously indicates a desire to perform the process painlessly, which may be sound theology, but is questionable science.

In presenting this subject for your consideration, I am well aware that the data are, in the present stage, merely suggestive, and that further study and experimentation are necessary in order to reach definite conclusions, but from the evidence at hand it would appear that our views regarding the so-called alkalinity of the saliva need fundamental revision,. that observations upon the reaction of the saliva based upon the use of indicators of its reaction are of very questionable value, that for precise work they are useless and finally, that the part which mucin plays in the protection of tooth structure against corrosion by acids needs to be more fully studied before we can decide that the use of alkaline dentifrices is wrong, much less than the use of acid dentifrices is right.

In closing I wish to acknowledge my indebtedness to my colleagues, Messrs. Crowell and Appleton, for conducting the experimental laboratory work upon which this paper is based.

THE MACHINE AND THE POWER[1]

By Dr. Frederick B. Noyes.

The dental profession has seen enormous changes. There have been the developments in inlay work, in prophylaxis, in anatomical occlusion of dentures, and in various other fields. I think it is safe to say that few fields in dental science have made more rapid progress in the last fifteen years, or have seen more radical changes than the field of orthodontia. Fifteen or twenty years ago the practice of orthodontia was very different from what it is at the present time. Originally, to go back still further, patients sought the dentist because of crooked, irregular, ugly teeth, to have their appearance improved. The one idea in their minds was to obtain a nice, even row of teeth. And the dental profession found that by using force the teeth could be moved, and, by devising means of applying force, they could be brought into "alignment." The end to be attained was "alignment"—the means was a mechanical device. Some men preferred springs, some men preferred screws. Some used wires, and some used plates. There were vast discussions as to the preference of one or the other. But the idea was a force and a machine to move the teeth and bring about "alignment." Many men achieved success to their own and their patients' satisfaction, and there were many failures.

The development of our knowledge usually comes from two sources—from the study of our failures, and from the search for the cause of the conditions that we are trying to treat. These two lines have led to the development of our knowledge of the mechanism of development, and of the relationship of occlusion to the mechanism of development.

Too much honor cannot be given to Dr. E. H. Angle for his share in the development of this knowledge of occlusion as a mechanism of development. He was the seer, the prophet. His was the vision, the inspiration, around which other men, gratefully or ungratefully, have built. As a result of this development

[1] Read before the American Academy of Dental Science, Boston, Mass., November 5, 1913.

of knowledge of the mechanism of development, there have been very important changes in point of view. There has been very radical reconstruction of our notions of things. It is my object to-night, not to present to you a paper reciting the results of any given piece of investigation, but rather an attempt to make vivid and clear, some of these changes in point of view—some of these radical reconstructions which have come about in the development of this subject.

One of the most radical and prominent results of the development of our knowledge of occlusion as a mechanism of growth has been the change in the time for beginning treatment. In the old condition of affairs, it was perfectly logical to reason that we should wait until all the teeth, except the third molars, had made their appearance and taken their position, and that then they should be moved into alignment. But as soon as certain definite factors were discovered in the mechanism of development, it was just as logical to argue that as soon as a definite defect in the mechanism is discovered, it should be corrected, in order that development may progress as soon as possible under normal, instead of abnormal, conditions.

Under the old ideas, it was necessary to wait until the patient was thirteen or fourteen years old, until the second molars had erupted before treatment was begun. Now, cases should be completed and dismissed by the time the second molars are in full occlusion and their cusps normally locked.

It is an exceedingly difficult thing to reverse the best opinion of a profession. Fifteen years ago scarcely a man could be found who would advise early treatment. At the present time, certainly all the men best posted in the field, advise early treatment. It requires time and patience and continued effort to reverse the best opinion of a profession, as expressed in its literature and in the minds of its most thoughtful men.

For success in the treatment of children, many things are necessary. Unless the result is to be the purest accident, the man undertaking the treatment of these children must first have a clear, definite conception of the exceedingly complicated mechanism of development. He must have a biological conception of tissues, their action and their growth. He must have lost the

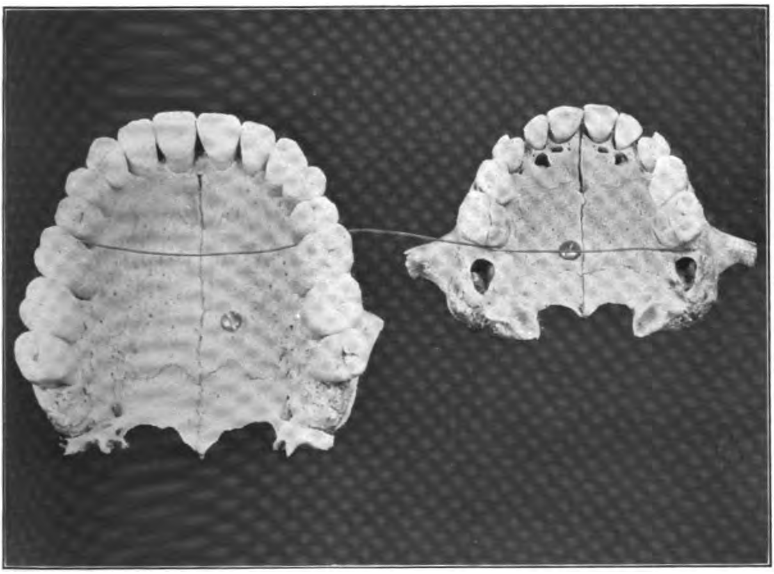

Fig. 1. The upper arch of a child and an adult

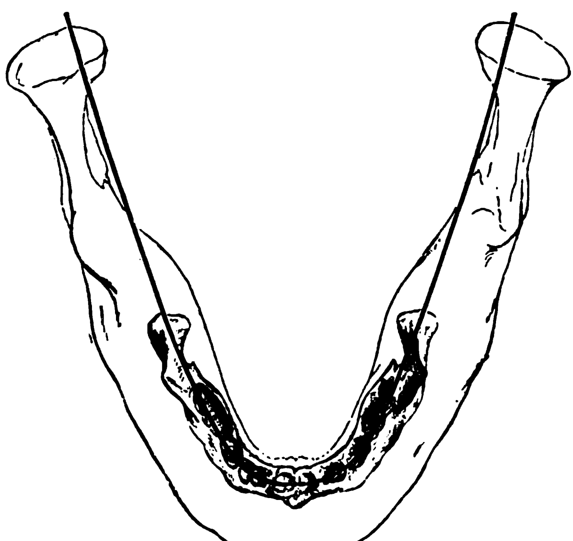

Fig. 2. Tome's diagram of the development of the mandible from infant to adult

Fig. 3. A section of bone showing the arrangement of the lamellae in three varieties

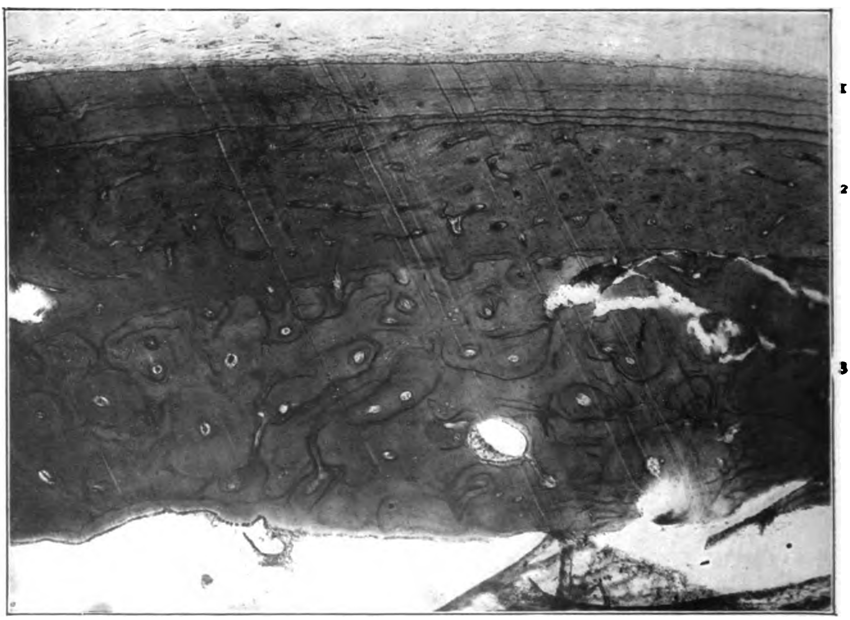

Fig. 4. Bone from the buccal plate of the mandible of a young sheep, showing transformations of bone: 1, subperiosteal bone; 2, Haversian system bone; 3, Haversian system bone, becoming cancellous

idea that appliances are machines to push the teeth into place, and have gained the conception that they are means of applying mechanical stimulation for the production of tissue growth. And last, but not least, he must have retained an open childlike mind, so that he can handle children and learn.

I remember very well as I began the study of dentistry that, in trying to get a conception of the growth of the jaws, I was led to suppose, more or less erroneously, that the jaws are developed at the back; that the baby arch represents the front half as far as the bicuspids (Fig. 1) of the permanent arch—and that the permanent arch has been made from the baby arch, by the adding on of spaces for one tooth after another at the back. You will remember the diagram of the infant mandible and its relation to the adult mandible (Fig. 2), and the importance laid upon the part played by the articular cartilage in the formation of the adult jaw from that of the infant. Those were the ideas with which I started, and gradually I had to change them.

We must first of all have some conception of the nature of bone. Bone has a long ancestry. It is the most highly specialized of the tissues of support, of which perhaps the simplest elementary beginning was the cell wall of the plant. We must consider bone from the standpoint of a tissue, made up of certain structural elements, arranged in certain typical forms in the three varieties of construction.

But besides considering bone as a tissue, made up of certain structural elements definitely arranged, we must think of bones as organs of support. A bone made up of bone tissue arranged in various ways, constitutes an organ of support. We must remember that while the bones of a skeleton, as we come in contact with them, are hard and unchanging after death, living bone is among the most plastic of tissues. I mean by that that it responds to changes of environment and nutrition, perhaps as rapidly as any other, or almost any other tissue. If, for instance, we develop the muscular system, we have changes in the bones as quickly as we do in the muscles. From the appearance of a bone, the skilled anatomist will give a very close estimate of the muscular development of the individual from which it was obtained, because the bone as a living tissue, has responded to the conditions under which it was placed.

We know those things, and still I think we do not appreciate the fact that the development of the highest types of individuals in normal life has been, to a certain extent, dependent upon reactions of bone adapting its form and size and structure to the functional requirements of the individual. We do not realize that bones continue to change throughout life. We do not realize that the form, for instance, is under constant fluctuation—that there is a mechanism in the tissue itself which produces changes in response to stimuli, never stationary, but running one way and then the other, maintaining its equilibrium by balance.

In the bone itself we find these histologic changes going on —what I sometimes call the metoses of bone, the fluctuations by means of which this wonderful adaptation of the skeleton is accomplished. In the development of bone, we find one illustration of that condition. In this section, which you will recognize (Fig. 3), you have on the surface the subperiosteal bone, which is continually being laid down as the bone is growing, in layers parallel to the surface, but is never allowed to become very thick. As soon as a certain amount of thickness has been produced, there are great absorptions occurring within it, cutting out large spaces, which are immediately rebuilt by layers arranged around those spaces, so that the subperiosteal bone is destroyed, and the Haversian system bone is produced. If the growth were continued, the bone would be almost solid, but after a certain thickness has been produced, absorptions begin in the Haversian canals, cutting them out into large, irregular spaces, and here the Haversian system bone is transferred into cancellous bone. The adaptation of the organ is maintained by the changes back and forth, and it is important to realize that those changes may go either way. We may have absorptions cutting clear through the subperiosteal bone and deep into the Haversian system, while lamellæ are laid down around the cancellous spaces, converting them into Haversian systems, and a few new layers of subperiosteal bone are formed on the surface.

Bone retains, as long as it remains alive the ability to adjust itself to its environment, and maintain a perfect balance of conditions. The bone, as an organ of support, is not only formed in relation to the mechanical conditions to which it is

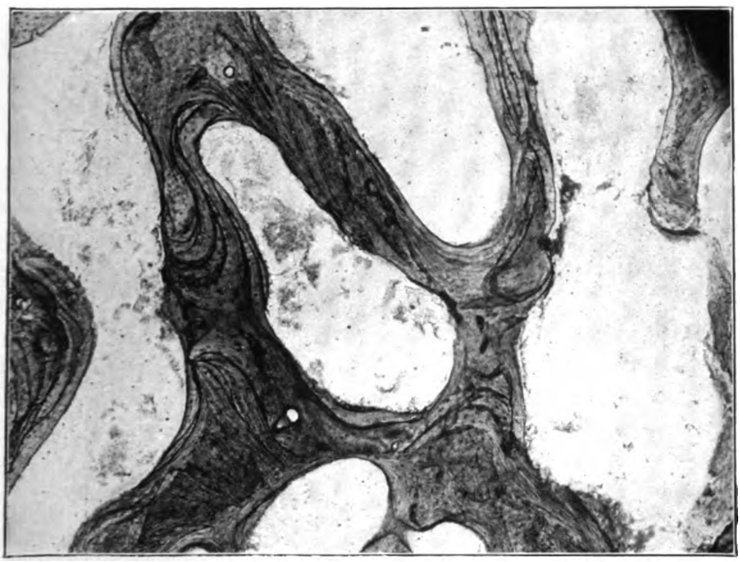

Fig. 5. Decalcified cancellous bone from the human mandible, showing absorptions and rebuildings, changing the directions of the spicules

Fig. 6. Section through the alveolar process of a temporary tooth: **D**, dentin; **Cm**, cementum, showing absorption and rebuilding; **Pd**, peridental membrane; **B**, newly formed bone at the border of the process; **Hb**, rebuilt Haversian system bone

subjected, but the very minute structure of the bone itself is arranged with reference to the forces to which it is, and has been, subjected (Fig. 4). Any section of bone will show these changes. Here, for instance, is a section from the mandible, showing the same transformations as in the previous slide. The subperiosteal bone is substituted for the Haversian system bone, a portion of which has been rebuilt, and the changes back and forth are very plainly apparent. The whole bone is an organ of support, arranged with reference to all of the mechanical conditions to which it has been subjected, not only in its general form, as represented in the outline of this section of the mandible, but in the structure of the tissue and the arrangement of the individual lamellæ.

This (Fig. 5) is another section from cancellous bone of a human mandible, showing the same condition of rebuilding. Notice the old layers that have been entirely cut off and rebuilt by layers of an entirely different character.

The alveolar process is, perhaps, one of the prettiest places to study these transformations. The bone is built up at the border of the alveolar process, by the peridental membrane on one side, and by the periosteum on the other, building up solid subperiosteal and subperidental bone in that position. That would make a solid mass if it were allowed to remain in that form, but as soon as a certain amount of it has been produced, enormous absorptions cut out the whole interior, and it is rebuilt by layers in a different direction (Fig. 6), so that the temporary alveolar process, for instance, around the temporary teeth, represents a veritable patchwork of bone laminæ laid down in all sorts of directions.

With that sort of introduction as to the character of bone, let us imagine the distribution of forces in the mandible of the infant. The form of the bone has already been taken on in a rough way. The periosteum has been formed. We have the development going on under the periosteum. The mass of the bone is made up almost entirely of the crypts of the deciduous and permanent teeth. This picture (Fig. 7) is used simply to show the beginning of the mandible at the time the periosteum is just beginning to form and to assume its place as an organ

of support. It is necessary to gain the conception of the whole structure as made up of millions upon millions of cells, all working, laying down and destroying bone lamellæ, and rebuilding them in new directions, enlarging those crypts as the tooth germs grow—a very factory of activity throughout its entire extent. And that activity is related to the mechanical conditions to which it is subjected, both from the organs which it includes (the teeth) and the organs which it surrounds (the tongue, etc.)—from the organs which are attached to it, and the organs which surround it. All of those mechanical conditions are reacting upon the exceedingly active tissue.

As the first teeth develop and erupt (Fig. 8), the lower incisors, having made openings in the arches of their crypts, are carried occlusally and outward, the upper incisors are carried downward and outward, and the lower incisors upward and outward.

In following these pictures, I am going to call attention primarily to the relationship of the development of one tooth after another, to the devolopment of the temporary dentition and the jaws. As soon as the tooth has made an opening through the arch of its crypt, and begins to move occlusally under the influence of a number of forces, among which are the development of its root and the growth of its dental papilla—the bone at the border of the process builds up as the tooth is carried occlusally, and the formation of the lateral alveolus resting against the central, not only carries the lateral upward, but helps to push the central occlusally also.

I have always felt that it was more or less important to notice the relation of the crypts of the inferior temporary molars to the inferior dental canal in this stage of dentition (Fig. 8). This whole bone does not remain stationary for any length of time, but is built and destroyed and rebuilt. It is fundamentally wrong to think that any part of this baby mandible is remaining in the adult mandible. Nothing that is there now will be there in adult life. It will have been destroyed and rebuilt, and this bone will be in a new position. The teeth that now occupy these positions in the upper arch occupy a position, which in the future will be somewhere up in the nose cavity of the adult,

Fig. 7. The skull at birth

Fig. 8. Dentition of about one year

Fig. 9. Dentition in the second year

Fig. 10. Complete temporary dentition, and the first permanent molar

for they are moving in three dimensions of space—downward, forward, and outward—with the growth of this bone, and under the influences of development of the germs and the stimulation of the normal physiological functions.

By the time the temporary dentition is completed (Fig. 9), the whole bone has been very much changed in form. All these teeth are in a much larger arch. Throughout the entire period of function of the temporary dentition, the temporary teeth are moving in three dimensions of space, under the influence of mechanical stimulus from normal function, exactly in the same way that they are moved by mechanical appliances in orthodontia. It is quite necessary to get a clear idea of that conception—that whether we put appliances on the teeth of children or not, the teeth are moving. If they are moving under the normal influence of the normal mechanism of development, they are moving in a normal direction. If they are in any way out of the normal influence of the mechanism of development, they are moving in an abnormal direction. If the stimuli are insufficient the development will lag.

As soon as the first molar takes its place (Fig. 10), added to the temporary dentition, and locks its cusps, an exceedingly important step has been made, because those teeth are not only to be the chief functional factors in mastication during the loss and replacement of the temporary dentition, but the locking of their cusps determines the balance of physiological forces as distributed upon the mandible. I mean by that, that in a certain way these two teeth represent the fulcrum upon which the activity of the muscles attached to the ramus and the posterior part of the mandible, and those attached to the anterior portion of the mandible, are balanced. If these teeth meet in their normal cusp relation, we have a normal distribution of those forces. If they meet in abnormal relation, we have an abnormal distribution of those forces between the two extremities of the bone.

I want to show you a slide of a small boy of eight years, where the lower molars have locked in improper relation (Fig. 11). Notice the protrusion of the chin, and the increased pull or tension upon the anterior part of the mandible, which has bent the entire bone. In these skiagraphs (Fig. 12) you see the spaces

between the first and second bicuspids and the first permanent molar. The distance here is greater than it should be, and the lower border of the mandible is bent, with the chin pointed downward.

As soon as all of the temporary teeth are in place and the first molars in occlusion (Fig. 13), the temporary teeth begin to be shed, but if the development is progressing normally before they are shed, the temporary incisors present wide spaces between them. If that does not appear, it is a positive indication that the bone is already underdeveloped, and that there is not room for the eruption of the permanent incisors with the increase in their mesio-distal diameters in the arch between the cusps.

I want you to analyze quite carefully, if you will, from this picture (Fig. 14), the mechanism which is related to the development which occurs at this period, increasing the distance between the symphysis and the mental foramen. Dr. Cryer a number of years ago pointed out that in the development from the child to the adult, the arch increased first in this region (illustrating), then later in the region from the mental foramen to the ramus. Note in this picture the relation of the central incisor as it erupts, with its partially formed root, to the two temporary lateral incisors. Note that the permanent lateral incisor lies just to the lingual and below the central, that the mesial angle of the lateral is locked in the distal angle of the central, and the mesial angle of the cuspid is locked in the distal angle of the lateral. The development and growth of the tooth germ has pushed the crypt wall down until it is resting against the cortical plate of the lower border of the mandible. The long cuspid as it develops carries everything upward, forward, and outward (Fig. 15), in a formation like the old football wedge.

As the growth of permanent teeth occurs in their crypts, the temporary teeth are carried upward, forward, and outward in three dimensions of space. They are moving under the influence of mechanical forces, the development of these teeth being only one of the mechanical forces to which they are subjected. Now, suppose the lateral misses its contact with the distal of the central? It is absolutely impossible to suppose that anything else

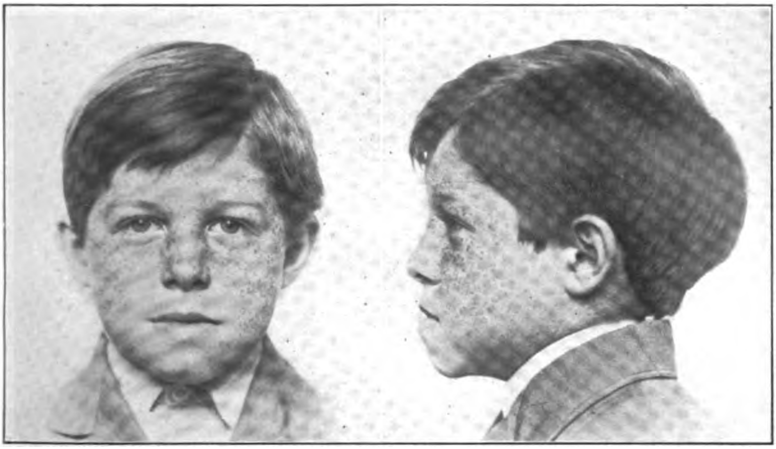

Fig. 11. The face, showing the effect on the mandible of abnormally balanced muscular action

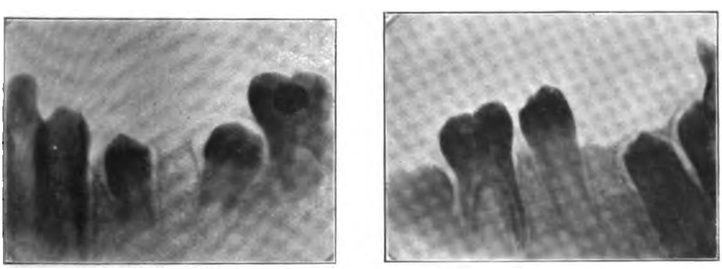

Fig. 12. Skiograph showing stretching of the upper border of this bone; the increased distance between the first molar and the cuspid

Fig. 13. Skull, showing the dentition in the eighth year

will happen than that it will be shoved into the lingual position. The arch will not increase to its normal extent, for the mechanism which should bring about that development has slipped a cog.

First, we must recognize the details of the cusp relation in occlusion, and realize that every cusp is of importance. The teeth in normal occlusion are all of them supported by all the others. They are held in balanced positions by their inter-relation with all the others. I am going to revert right here to one thing which comes to me very often—it is absolutely impossible for one tooth to be out of place and any other tooth to be where it belongs. I do not know how long it is going to take the profession to realize that. The whole of occlusion is a mechanism which works together. You cannot disturb one cog of the machine and have the rest of the cogs in the wheels fit together right. The positions of those teeth are determined by the balance of the machine, occlusion and the power—the force of function. The machine is the mechanism of occlusion—the power which acts through it, leading to the development of the bones of the face, is the mechanical stimulus of normal function.

It is never sufficient just to establish normal occlusion. You may place the teeth in their normal cusp relations, but unless the functional forces are properly exerted they will not move in their proper directions in growth. Development, in other words, will not progress normally unless you have both the machine and the power. Your automobile may be all right, but if there is no gasoline in it, it will not go. Your cusp relation may be properly established, but unless the forces of normal functions are normally exerted and normally balanced, they will not continue to develop properly.

Now, one of the forces, is of course, mastication; but I do not by any means consider that the most important. Respiration is certainly exceedingly important, for in respiration normally carried out, not only are the teeth brought into cusp relation with more or less force, but the actions of all the muscles of respiration exert influences upon the teeth through their occlusal surfaces, and upon all of their other surfaces, which react upon the development of the bone. If the teeth are in their proper cusp relation, that force will be balanced and distributed

throughout the entire bone, and normal development will result. If the teeth are not in normal cusp relation, that very normal force will drive them farther and farther away from their normal positions. On the other hand, if the normal relation is established, and the patient is allowed to go on with abnormal breathing, the development is defective just in that proportion.

It is not enough that we should have normal breathing, but we must have normal vigor of breathing. The bones respond to mechanical stimulation, and they must have some force in the stimulation if they are to respond with any development.

Let us take up deglutition. Do you stop to realize that we swallow once in two minutes, day and night? Just swallow once, noticing the conditions, and you will feel a pull on the hyoid bone, compression of the tongue, contraction of the lingualis and hyoglossus muscles. Deglutition and respiration are very closely related to each other, especially in sleep, and unless the mouth is closed and the lips are sealed, we fail entirely of the influences on the arches of the act of swallowing. The act of deglutition is very intimately related to the normal reflex of normal breathing, particularly in sleep. Without it, normal nasal breathing in sleep is almost, if not quite impossible.

We might spend the whole evening upon the influence of speech, peculiarities of speech, habits of speech, and its modifications on these directions of movement, but we cannot take the time for that.

In the study of my practice in the last few years, I have been more and more impressed with the idea that patients who come from the wealthy and middle classes show deformities due, in a great proportion of cases, to lack of vigor of normal functions. Not, perhaps, a positively abnormal function, but simply that that child never does anything with all its might. It never is taxed. It does not have to exert itself up to the limit of its physical powers and, consequently, particularly in respiration we fail in the normal force of stimulation which is an essential factor in the development of the normal size and character of those arches.

In speaking of some other classes of cases to a man whose specialty is the treatment of diseases by the development of muscle vigor, the first thing, almost, that he said to me was, "How do you expect that child to use normal vigor in respira-

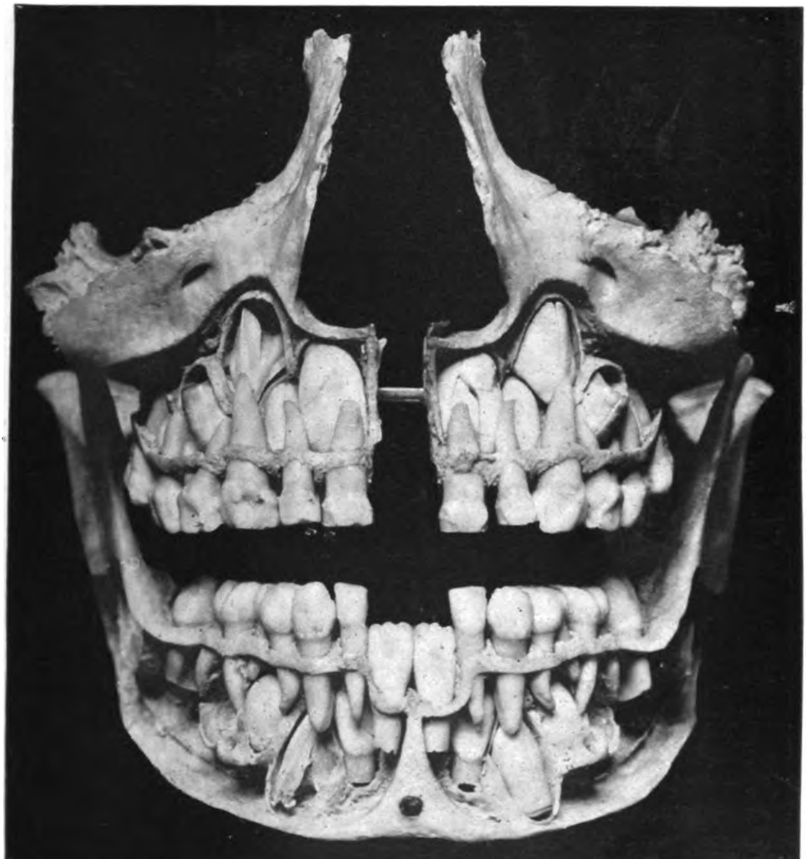

Fig. 14. Front view of the skull in the seventh year, showing the relation of the incisors and cuspids in growth

Fig. 15. Skull showing dentition in the eleventh year. Compare with Figs. 13 and 14

tion and mastication when he hasn't normal muscle tone in any muscle of his body?" You cannot have full vigor of the muscles of respiration and mastication if you haven't full vigor in any muscle anywhere. The important thing, then, is not simply to see that that function is normal, but to get some vigor into it. And it is as much a part of the treatment of malocclusion to see that the normal physiological forces are at work, as it is to use some infernal false force to produce the work. As soon as the cusp relation is made normal, we ought to be able to bring about normal development by normal forces, and we have failed, and have continued to use artificial force time after time, because we failed to focus our attention upon the physiological forces that ought to be at work.

In my opinion, one of the greatest fallacies into which the orthodontists as well as the rhinologists have fallen, has been the assumption that if the obstructions and faults in the mechanism were removed, that normal function will be resumed. In other words, that as soon as the nasal passages were cleared and the teeth moved into position, that normal breathing would immediately begin. Perhaps this is so in a few cases, but not in the majority of cases. Why should you expect them to? That child has for years been carrying out an abnormal reflex habit. The whole training of nerve stimuli in the process of the acts of respiration have been abnormal. The normal tracts have not been used. Why should you expect them to be used when you know that the stimuli will travel the same old tract unless it is driven out? In other words, in the treatment of these conditions where the cause of a defect is an abnormal form of respiration, it is not enough to assume that respiration will become normal as soon as this defect is removed, but we must definitely direct our efforts toward the establishing of a normal, to substitute an abnormal reflex.

Now, that is often done in an exceedingly awkward way, in a very bad way, in a way which is positively a detriment rather than an aid. I remember one very good lady who would say to a child every few minutes, "Ted, shut your mouth." She did not realize that she was making it just so much harder to break up the abnormal reflex. She was calling attention to it without doing anything to change it. Instead of that method, I think the

most effective method to break up an abnormal reflex is to exercise an exaggerated normal reflex in some way that calls no attention whatever to the abnormal reflex, taking particular pains when you are describing what you want the child to do, not to tell him that you are doing it to break up the old habit. Just tell him to do it for you, and do it regularly, just for the fun of it, if you can.

I believe there is no field in this subject that is bound to attract our attention more closely in the future than the field which requires the study of the habits of the individual to establish normal instead of abnormal habits, to bring about normal development.

Finally, it seems to me that orthodontia has made very great progress in the last fifteen years, and what it makes in the future depends, in my judgment, upon the attitude of the dental profession. It has been utterly impossible for me to conceive the purpose of any attempt to prevent orthodontia from becoming a specialty of dental practice. If there is anything that is enough to occupy all the enetgy of the most energetic man, it is this study of the phases of orthodontia, in its technique, its fundamentals and in its practice. The man who will acquire a working knowledge of this complicated mechanism which brings about the normal or abnormal development of the bones of the face, has something which taxes his ability to the fullest extent. He has in every aspect of the subject all that the most able man can hope to do, to become able to cope with the problems presented to him; and for that reason, men have devoted themselves with energy and with more or less enthusiasm to orthodontia, because it attracted their mental capacities. It is utterly inconceivable that men will attempt to do things for which they have neither the time, the inclination, nor the intention of equipping themselves properly to handle. I can see that if we stand together as one profession to the building up of our knowledge in these lines, it will be of the greatest advantage, not to ourselves, not to any group, but to humanity. And in that study I want to say as the last word, that the important thing is to learn how to make the physiological functions produce the power—to study the machine and the power that we may bring about normal balance and develop *normal faces* among our people.

TREATMENT OF ORAL INFECTION IN ITS RELATION TO SYSTEMIC DISEASE.[1]

BY JOSEPH HEAD, M.D., D.D.S., OF PHILADELPHIA.

The disease of pyorrhea alveolaris, in spite of its name, is not always associated with a flow of pus from the infected tooth sockets. As a matter of fact, pus does not appear in 25 per cent. of the cases. The main symptoms are inflammation of the peridental membrane, bleeding of the gums at the slightest touch and tendency for the teeth to elongate and be sensitive to mastication. Finally, the gums separate from the roots of the teeth, forming pockets where salivary calculus and infection cause such centres of irritation and disintegration that the destruction of the teeth involved is only a question of time unless the tartar is removed from the roots, the mass of infection destroyed, and the gum stimulated to reattach itself to the root.

Pyorrhea alveolaris unquestionably has a systemic as well as a local origin. It is frequently associated with no particular systemic disturbance that either the physician or patient can distinctly note, and yet these apparently non-toxic cases, under skillful treatment, will almost invariably show systemic improvement of a subnormal condition, that up to the time of pyorrhea treatment had been unsuspected both by patient and physician. It is a common occurrence for a patient under treatment for pyorrhea to say, "I have not felt so well in years, and I can only attribute the improvement to the pyorrhea treatment." When this statement is made by patient after patient independently, and is associated with a gain in weight or rise in hæmoglobin from 67 to 93, or a disappearance of chronic constipation, etc., it indicates strongly that there are no real cases of non-systemic toxic pyorrhea. It strongly indicates also, that all foci of infection in the mouth, although some may be apparently well borne, are a source of toxemia, that are a constant menace to the health of the patient, and that may eventually prove the direct primary cause of death.

A single blind fistula from an infected root may cause the

[1] Read at the meeting of the Allied Societies of Boston, December 17, 1913. See disc., p. 241.

most profound nervous depression which, being chronic, will only be recognized by its disappearance with the cure of the fistula. Osler, Goadby, Daland, Hunter, and Billings, I believe, have mentioned the bodily ailments that time will show to be directly traced to mouth infections. That mouth infection is, in a great majority of cases, associated with Bright's disease, diabetes, cardiac, hepatic, renal, and stomach disorders, has been known for a long time, but within recent years it has been shown that these disorders are, in many instances, ameliorated, and, at times, entirely eradicated by the removal of the infecting foci from the mouth. My experience in the treatment of pyorrhea alveolaris with its associated tooth infections, accords with these findings.

The development of medical science has now placed on the dentist not primarily the repair and restoration of the teeth that they may look well and give efficient power of mastication; medical science has primarily placed upon dentists the responsibility of deciding whether or not patients shall be inflicted with a long list of diseases that owe their origin and existence to infections within the teeth and the adjacent tissues. This question of autotoxemia has been a great shock to the prejudice of the medical world at large; but to the dental world, trained more along purely mechanical lines, with little or no bacterial knowledge, the question of autotoxemia is no less than revolutionary. It is as though cabin boys had suddenly awakened to find that they had been steering the ships of the human fleet without charts or knowledge of navigation, over rocks, whirlpools, and mines, all the time blaming the death and disaster on unavoidable Fate, when the wrecks, deaths, and disasters were directly caused by their own well-meaning blundering hands. The medical world at large cannot escape this indictment, but Dentistry, inasmuch as she recommends appliances and fixtures that cannot be cleansed, that obviously may cause and perpetuate toxemia—Dentistry is overwhelmed by the contemplation of the long lists of preventable diseases and gruesome toll of deaths that her well-meant efforts may have unwittingly occasioned. The manifestly undisputed fact that the removal of non-cleansable crowns and bridges have caused the rapid disappearance of heart murmurs, violent nerv-

ous derangements, duodenal ulcer, anemia, etc., is a convincing proof of what wholesale disease had been caused by the mechanical appliances now generally recommended.

Dr. William Hunter, in his article on "Oral Sepsis," published in the *Lancet*, January 14, 1911, did not overestimate the danger associated with such appliances or methods. In the light of our present knowledge any dentist that puts in a bridge or crown that cannot be cleansed as thoroughly as any one of the natural teeth, or knowingly allows foci of infection to continue in the gums or root canals, is endangering his patients' health and life, and I have no doubt that such procedure in the near future will be accounted malpractice. Yet, to be sure that there are no infecting foci requires a discrimination that taxes the ability of the trained, conscientious dentist to the utmost. One canal of a molar pulp may have died, spreading infection throughout the system, while the rest of the pulp being alive may cause the tooth to appear normal.

Pulps under fillings, although alive, may have become infected from the decay prior to its removal and so cause a fistula, open or concealed, that on account of the living infected pulp is difficult to diagnosticate. And, again, where pulps have died and have been removed from teeth, especially molars, it is a matter of great nicety to be sure that all the root canals are filled so as to be free from toxemia spreading infection. The X-ray is of great diagnostic value in these cases, but even with the X-ray these are difficulties that will always require nice discrimination and judgment. However, there is no excuse for allowing obvious fistulas to continue to discharge their contents into the mouth or blood current. The loss of a tooth or two in comparison to the evil of such a condition is not to be considered. But as a matter of fact, any conscientious, trained dentist knows that ninety-nine out of a hundred of the abscesses and fistulas can be readily cured without the loss of any teeth.

When we come to pyorrhea and pyorrhea pockets that the great majority of dentists class as incurable, we have come to the great divide, for insomuch as those dentists shall control and cure this great scourge, pyorrhea alveolaris, so shall they take their places in the dentistry of the future, and insomuch as

they neglect this great source of human disease, so shall they be relegated to the spheres of those who have unwisely attempted that which they are unfitted to accomplish. For the cure of pyorrhea alveolaris has been more or less successfully accomplished for the last fifteen or twenty years.

While, as previously stated, pyorrhea is associated with various disturbances of which it may be the primal and continuing cause, such as gout, Bright's disease, diabetes, cardiac, hepatic, and renal disorders, such specific diseases as syphilis, gonorrhea, and tuberculosis by their debilitating effect on the tissues of the mouth, may so lower the vitality of the gums that infections that otherwise would be repudiated, penetrate the peridental membrane, and by a subtle toxemia still further depress the general vital forces. This infection having penetrated the gums, forms a small abscess that partly strips away the peridental membrane from the tooth neck forming a pocket, which, once being formed, continues the disease even after the general systemic disorder may have been conquered. It is probable that some one of the numerous passing diseases, such as typhoid, measles, grip, or even a bad cold, has temporarily lowered the physical resistance of the gum tissue to the point of permitting the ever present infection to penetrate and form the self-perpetuating pockets, thus leaving the pyorrhea to continue without apparent systemic cause. Where the systemic cause has passed and the pyorrhea has not created a new one, the disease may, perhaps, be successfully treated by local means and a permanent cure hoped for. But where pyorrhea is associated with serious general disorder, local treatment, important as it is, can only be held as a palliative, and must be supplemented by judicious systemic treatment.

The most important systemic treatment in the cure of pyorrhea consists in the discriminating use of vaccines that will produce antibodies in the blood as supplementary adjuncts to the proper local treatment. And yet important and valuable as the vaccine treatment unquestionably is, without the proper local treatment that removes infecting foci and stimulates the gums to heal and reattach themselves to the roots, vaccine treatment can only reduce the severity of the symptoms. It cannot effect a cure.

Up to within the last four or five years instrumentation that removed bacterial masses and tartar scales from the roots beneath the gums was the chief reliance for the cure of pyorrhea alveolaris. It is true that various medicaments, such as 75 per cent. lactic acid or 50 per cent. sulphuric acid were used with the idea of softening the scale and rendering it mcre easy of removal. The great objections to these medicines lay in the fact that when diluted by the fluids of the mouth they would attack the enamel of the teeth more rapidly than the tartar. A number of dentists have been able to tighten single-rooted teeth partly by scaling and partly by splinting to adjacent firm teeth, but in cleansing the calcareous deposits from the bifurcation of roots only a few dentists have succeeded, and some of these by the ruthlessness of their instrumentation have at times caused unjustifiable injury to the cementum and pulpal vessels. It has also been noted that deep pockets occasionally appear around a tooth that is sensitive and loose during mastication, and yet the most careful manipulation of the scaler has failed to show the presence of the tartar scale. This seems to prove that the mere absence of tartar is not a sufficient circumstance to effect a reattachment of the gums to the root. What we need is an efficient antiseptic solvent that will soften the tartar attachment to the root to expedite instrumentation, that will dissolve any microscopic portions inadvertently overlooked, an antiseptic that in destroying the bacteria within the adjacent gum tissue, will not depress but simulate the tissue cells, so that they will form reattachment of the gum to the root, thus causing the disappearance of the pocket, which is the self-perpetuating focus of infection. This medicine we have in the 20 per cent. aqueous solution of bifluoride of ammonium with 10 per cent. free hydrofluoric acid.

Some seven years ago it was my good fortune to discover that commercial hydrofluoric acid would disintegrate tartar with no microscopic action on either cementum or enamel of an extracted tooth. The poisonous action of this acid alone precluded its use as a therapeutic agent to be applied to the gums. Through an extensive series of experimentation it was proven that a 20 per cent. solution of bifluoride of ammonium with 10 per cent.

H F, will disintegrate the tartar on a tooth and leave the tooth apparently unsoftened. This mixture has germicidal strength of 5.82 times pure carbolic acid, and on most mucous membrane is non-escarotic.

A practical non-dangerous method for its manufacture is as follows: In a wax or platinum dish place 17 c.c. of C. P. hydrofluoric acid. To this slowly add 13 grams of C. P. ammonium fluoride. Fill up with water to 100 c.c., and allow to rest for twenty-four hours and the mixture is ready for use. Of course, the ammonium fluoride and acid will have to be added according to their percentage of purity. This mixture can also be made with the bifluoride of ammonium, 20 grams being slowly put into diluted 10 c.c. of C. P. hydrofluoric acid, and then in a like manner filled with water up to 100 c.c.

The solution of bifluoride of ammonium thus obtained gives excellent therapeutic results. I also use a 20 per cent. solution of bifluoride of ammonium with only 5 per cent. free hydrofluoric acid. This is valuable where there is excessive gum inflammation, as it can be applied without the pain which the first one or two applications of the ordinary solution is apt to occasion. When the inflammation is reduced the stronger solution can be painlessly and advantageously used. The solution of ammonium bifluoride may be injected once or twice a week into pockets around loose teeth, but care must be taken not to inject it into fresh cuts, as such a procedure will cause great pain.

The patient should spit without rinsing the mouth with water, the saliva acting as a protection against irritation. After one or two injections the soreness and inflammation will largely disappear, and even the general symptoms of toxemia will be sometimes found to have abated. The tartar scale that could not be easily and painlessly removed at the first two sittings, will now tend to be so loosened that its thorough removal by scalers will be easy for both patient and dentist. After four or five applications, one week apart, black scales that have escaped the instruments will sometimes be found floating loose in the pockets, so that they can readily be picked out, and finally the root will become as smooth as velvet to the touch of an instrument. When this stage has been reached it will be found that the scalers can-

not be as deeply carried into the pyorrhea pockets as was easily possible in the beginning. To do so causes pain and a free flow of blood. This indicates that new granulations are forming, and these should not be ruthlessly broken up either by instrumentation or by injection of the bifluoride into them.

The solution should be gently flowed into the pockets each week, a procedure which results in continual healing and is not productive of pain. Careful exploration for tartar on the root within the pocket is always advisable. Reattachment of the gum to the root, however, can be accepted as assurance that that portion of the root has been thoroughly cleansed, and so the scaling in that place should be discontinued, while the weekly applications of the bifluoride solution should alone be used. If, however, at the end of two or three months any of the pockets have not entirely healed, they should be re-explored with scalers and the treatment repeated as for a new case, although by this time most of the original pockets will have disappeared, and where they existed, the gums, with a slight contraction at the neck, will be found firmly adherent to the tooth. Teeth that have lost more than half of their gum attachment, under this treatment have become firm and comfortable to the action of normal mastication.

Let us now consider some of the other means of local treatment in the cure of pyorrhea alveolaris. Loose teeth may be splinted together so as to give immobility, but this should always be done in such a manner as not to prevent thorough cleansing of the gum around their necks. Any malocclusion should be remedied so that loose teeth may be relieved of the excessive pressure of mastication due to thickening of the inflamed peridental membrane. When a pocket has approached an apical foramen near enough to infect the pulp, the pulp should be destroyed and the root canals thoroughly sterilized and filled. This should be especially looked to in the case of molars where the pocket extends through the bifurcation and down to the tip of one of the roots.

It is sometimes excellent practice to cut the crown midway through the grinding surface through the juncture of the roots, finally extracting the diseased root with its side of the crown.

This exposes the other root or roots so that they can be filled and cleaned as easily as a bicuspid. With upper molars, where the palatal root is necrosed, this operation is most satisfactory as it leaves the mouth, to all appearances, unchanged. This operation makes it so that the remaining root or roots do not have to stand more than their fair share of mastication, and so works for greater stability and a more rapid recovery.

An excellent mouth wash for use at home consists of a saturated aqueous solution of sodium silicifluoride, which amounts to a .61 of 1 per cent. solution. This, when held for a minute in the mouth, morning and evening, and freely swashed through the teeth is a great assistance in relieving inflammation of the gums. It has no perceptible antiseptic coefficient, but, like the bifluoride, it seems to restrain the deposition of tartar on the teeth, except in about 1 per cent. of cases, when it seems to slightly increase it. But even in these cases the gums heal promptly, and the superficial deposit is easily removed from the teeth with brush and pumice. The disagreeable flavor of the solution can be disguised by adding an equal amount of sodium chloride or a judicious quantity of aromatics.

An efficient tooth powder that will liberate enough free oxygen to make 40 to 50 drops of a 3 per cent. peroxide solution for every ten grains used on the brush in the mouth is as follows:

Peroxide of magnesium (No. 200 mesh sieve) ..	60 parts
Perborate of sodium	30 "
Castile soap	10 "
Flavoring	

This can be used morning and evening to brush the teeth, and should be swashed around the interstices for a full minute before being ejected from the mouth. But, above all, the teeth and gums should be thoroughly cleansed and brushed morning and evening. Without this, antiseptic washes will be of no avail. Floss silk and the toothbrush are the instruments to this end. Since the toothbrush cannot cleanse between the teeth, these surfaces should be swept free from bacterial deposits with floss silk morning and evening, and then the teeth and gums should be thoroughly brushed with strokes not less than an inch and a half long, and rotary wherever possible. The brush should be small.

not over an inch and a half long, the bristles not over a quarter of an inch, and narrow, so that when the mouth is partly opened the brush can be placed between the ramus of the jaw and the third molars. Most brushing does not extend beyond the spring of the bristles which, instead of giving bristle friction, merely pivots the bristles without cleansing. The upper and lower third molars more frequently decay, and are subject to pyorrhea alveolaris simply because they are not cleansed. Structurally, they are not weaker than any other teeth.

At each visit of a patient it is most essential that an examination should be made of the necks of all the teeth for bacterial plaques that may have been accumulating undisturbed since the last visit, and these should be pointed out to the patient, and he should be shown what movements of the brush are necessary for their removal, so that in the future he may know how to properly cleanse the teeth and gums. For, a final test of a method of brushing the teeth and gums is, does it clean away the bacterial plaques? Ninety-nine out of a hundred of cleanly people in this world never brush the thick bacterial plaques from their third molars, or, as a matter of fact, from half the other teeth. They simply have never been taught and do not know how. Gums, as well as teeth, should be thoroughly brushed twice a day to clear away all bacterial plaques, and observation of my patients proves that healthy gums are no more injured by vigorous brushing than is the skin adjacent to the finger nails.

Inflamed soft gums will unquestionably be made sore for the first week or two, but persistence on the part of the patient and assistance on the part of the dentist in touching up the sore spots with nitrate of silver will soon strengthen the gums to almost any friction the toothbrush can give them. The question of vigorous cleansing and massaging the gums with the brush is not only a question of removing external films of infection, it is for the purpose of producing an autoinoculation that will create antibodies in the blood for the purpose of combating the disease, and a vigorous massage of the parts causing a local hyperemia, thus enabling the antibodies in the blood to come into more intimate contact with the infecting bacteria.

This is a most important phase in the cure of pyorrhea, and

one that has not been sufficiently emphasized. For the formation of antibodies for the cure of pyorrhea is a means of eradicating pyorrhea from the system. The autoinoculation caused by vigorous gum brushing combined with the judicious use of carefully prepared vaccines have given results of a systemic improvement that are little less than marvelous, and the judicious use of vaccine, the systemic cure of pyorrhea alveolaris, will now be considered.

Medical literature is so full of the reports on successful vaccine treatment for mouth infection that they cannot but convince the most skeptical that there must be value in the treatment. Goadby's work in this field is deserving of great credit, and one of the more recent articles on this subject wherein Goadby's methods are followed is by Robert C. Cummins, *Journal of Vaccine Therapy*, March, 1913. The work of Leary and his associates is more in accordance with modern bacteriological methods, and their reports are more in accordance with the bacterial findings of this paper.

Some two years ago I began the vaccine treatment as an adjunct to my local pyorrhea treatment. I was decidedly skeptical because pyorrhea does not seem to be caused by a specific bacterium, but may be caused by any one of several species, or various combinations of these. Nevertheless, from the very start such increased improvement locally and systemically was obtained that the great value of the treatment could not be doubted. The results in almost every case showed a consistent healing of the pockets and a disappearance of infection from the gums. In about 50 per cent. of the cases there was a distinct improvement in the general physical condition that, as before stated, from being chronic was sometimes made more apparent by its absence than its presence. In the forty cases that are used as the basis of this report, the streptococcus, staphylococcus, bacillus influenza, pneumococcus, micrococcus catarrhalis, diphtheroids, Friedlander bacillus, and an occasional unidentified bacterium were used in the vaccines. The streptococcus viridans appeared in about 90 per cent. of the cases during the winter, but later in the spring and fall it was not found at all. That the vaccines for pyorrhea alveolaris for forty cases contained such a consistent combination of similar germs for so many cases with so com-

paratively few unidentified strains, may be partly due to the method used in collecting the specimens so as to exclude the incidental or extraneous flora of the mouth. My method will now be described.

When the infected area appeared at the tip of a root where the pulp had died, and the root canal had been filled, the culture was always taken through the root canal which was drilled out with a fine sterilized piano wire drill until the end was nearly reached. The canal was then sterilized with carbolic acid, wiped dry with cotton and then blown out with hot air. When this had been accomplished and the tooth had been carefully guarded with a napkin to prevent infection from the mouth, another sterilized drill was passed down to the end, and then plunged through the tip into the infected area. This was then streaked over the blood agar in the ordinary manner.

At times, however, the infected area appeared near the tip of a root or roots where the pulps were alive. In this case the root canal method of obtaining the specimen was not feasible, so the following method was substituted.

The mucous membrane over the indurated infected spot was cocanized, and a thin cautery plunged down to the bone. A sterilized bone drill was then passed through the outer plate of the alveolar process, and the patient dismissed for two days. On his return the opening in the gum on being protected with a napkin, was cauterized with pure carbolic acid and then wiped dry. Then the sterilized point of a small sterilized platinum pointed glass syringe or platinum spear was inserted into the bony opening made previously by the drill, and a small drop of bloody fluid extracted, which with due care was transferred to the blood agar medium. This material was supposed to contain the bacteria that had gathered for the purpose of preventing reorganization of the tissues.

To take a specimen from a pyorrhea pocket, the following method is used: The neck of the tooth and edge of the pocket are first lightly cauterized to destroy all outside bacteria. The tooth is protected from mouth infection by a napkin. Then a small cup-shaped spear of thin platinum having been heated to a cherry red is plunged to the bottom of the pocket so as to get not only the pus in the bottom of the pocket, but also a slight amount of blood

from the walls of the cavity. The spear is then withdrawn without touching any other portion of the mouth and streaked over the blood agar. It is thought that the hot platinum will kill any extraneous flora, while the cooled metal will carry to the blood agar only the germs directly responsible for the disease in question. It must not be forgotten that pus is sometimes sterile, while the true cause of infection may lurk within the walls of the abscess from which the material is being obtained.

The vaccine was then made up so as to contain all the germs found, barring the spore formers and the anærobes that were not grown. While the bacteria of these classes may sometimes play a role in the infection, the results of vaccine treatment indicate that in these cases their rôle is a minor one. The staphylococci were made to give 300 million to the c.c. Streptococci, diphtheroids, pneumococci, micrococcus catarrhalis, bacillus influenza, and unclassified bacteria were put in so that each would show 50 million to the c.c. In ordinary cases of chronic pyorrhea, the initial dose is 75 million staphylococci and 12 million of each of the other bacteria, and the dose is steadily raised according to the reaction at the site of inoculation and the general systemic response. Where the patient showed exceptional frailness or the inflammation was exceptionally acute, the initial dose was reduced to 37 million staphylococci and 6 million of each of the others. These doses were generally given a week apart in the arm, or, in thin patients, in the back.

I have not used the opsonic index in the treatment of pyorrhea alveolaris. I feel that clinical symptoms have been a sufficient guide. An interesting observation which I have not seen mentioned elsewhere is the occasional persistence of the induration which forms at the point of injection. It has appeared to me that this can only be due to a lack of digestion and absorption of the bacterial bodies. So long as the induration markedly persists we have an indication that the potentialities of the vaccine injection have not been exhausted. Therefore, further injections may be temporarily withheld or smaller doses given while absorption in the seats of induration is stimulated by massage. This method gives excellent results, and tends to minimize the danger pointed out by Allen,[2] where excessive reaction is caused

[2] Vaccine Therapy and Opsonic Index, page 112.

by doses which may have been perfectly well borne on several previous occasions. But as Allen said, it should always be borne in mind that where the systemic reaction lasts over twenty-four hours, it is wise to increase the interval between the doses, and a larger dose should not be given especially if the patient makes good progress on the smaller dose.

Where there is a tendency to the rapid formation of creamy tartar deposits on the teeth prior to vaccine treatment, it will be noted that as the antibodies are formed and the gums show signs of healing, that the tartar will be deposited much less rapidly, and what tartar is deposited is of a more solid removable nature that does not tend to burrow under the gum margin. This change in the deposition of tartar, I have finally come to regard as a distinct symptom of the successful progress of the vaccine inoculations.

When a pyorrhea pocket shows sudden signs of inflammation during treatment, it is always wise to open it surgically with a drill along the root to be sure that there is no back pressure of pus, and that the antibodies have full opportunity to enter the seat of infection for the purpose of aiding in the cure. For, above all things, it should be remembered that the vaccine treatment can only be successful when accompanied by judicious local treatment of a surgical and therapeutic character. And this applies to all foci of infection whether in the gums or in the impaction of a bowel, the genito-urinary system, or anywhere else in the system. Therefore, it is imperative that there should be sympathetic co-operation with the family physician, whose intimate knowledge of the patient, and whose careful diagnosis of foci of infection other than those found in the mouth, will greatly increase the percentage of successes, and add to the permanency of the cures.

I shall now report a few detailed cases:

A young man with pronounced pyorrhea and several fistulas in the gums came to me so despondent that he thought he was going to die. Local treatment caused improvement, but two of the fistulas would not heal. An autogenous vaccine was made March, 1912, from material obtained from the worst fistula. It contained only a single strain of streptococcus. After four in-

jections, a week apart, he gained in weight, and then he started to slowly lose weight, but as he felt better and the gums improved, the treatment was continued up to June, when there was a great improvement in the gums, and both fistulas had healed. In the fall he returned, and, as he and his family physician said, the vaccine had done him so much good, I made another vaccine from a small pyorrhea pocket, and obtained four strains of streptococci and a staphylococcus aureus. This treatment caused a complete healing of the mouth, so that it was apparently absolutely healthy, his skin cleared, he gained weight, and felt, as he said, well. The mixed vaccine seemed most effective.

He begged me to give the vaccine treatment to his wife, who also was suffering from pyorrhea. She had almost the same experience, except that she did not gain weight (her weight was normal), but her mouth showed great improvement, and she slept better and felt a great lessening of nerve tension.

Mrs. A——, of about fifty years of age, came to me with all the teeth loose, complaining of great fatigue, trouble with the eyes, constipation, and a steady loss of weight. In six months the vaccine treatment had markedly tightened the teeth, and her chronic fatigue and constipation were gone, the wrinkles vanished from her skin, owing to an increase of weight from 115 to 127, and all of her friends asked the cause of her improved condition, which she attributed to the vaccine. Her eyes, she claims, were so improved that she could readily read what before was impossible or accomplished with difficulty.

A married woman of forty, who had been under my local treatment for some two years, took a vaccine about a year ago composed of streptococcus. She had a complexion covered with red patches, gout in the right eye, hæmoglobin 67, and great depression with constant fatigue. In six months her hæmoglobin went up to 93, the gout disappeared from the eye, her complexion cleared, and the gums made more progress than had previously been made in two years under local treatment. Her greatest satisfaction lay in the fact that she slept well, which, prior to the vaccine treatment, had not been the case.

All my treatments have not been as dramatic or startling as the last two mentioned. However, in three cases as the gums and abscesses healed, marked redness of the nose disappeared.

This was associated with great clearing of the complexion and a gain in weight. In other cases there was a consistent healing of the gums that seemed much more rapid than that usually obtained from local treatment alone, but with many of them the time is too short to be sure of a permanence in cure.

In one case that refused to yield either to local or vaccine treatment, a tumor of the breast was discovered. Such a depressing focus was obviously a sufficient reason for the poor results obtained, and as the patient refuses to have an operation the prognosis is not good.

In fairness to local treatment alone, I wish to report a case that is typical of its class. A young doctor came to me suffering from a case of badly infected enlarged tonsil on the right side, which he said he believed came from a pyorrhea infection. A superficial examination of the mouth showed a beautiful healthy set of gums and teeth, but a further investigation with an explorer demonstrated the presence of a deep pyorrhea pocket between the second and third upper right molars. There were also one or two minor pockets on the other side of the mouth. I took the material for an autogenous vaccine, made an application of the bifluoride solution and sent him away. In a week he returned, and to my surprise the tonsil had returned to its normal size and condition. And I am free to admit that if I had used a vaccine I should have given the vaccine the credit for the tonsil's recovery. Later, I used the vaccine, and am treating him now with excellent results. But I mention this case as a caution to those who would underestimate the systemic results that may be obtained by judicious local pyorrhea treatment.

Once more, let me say that vaccines judiciously combined with local treatment seems to be so valuable in the cases of pyorrhea that they should, in my opinion, always be given a fair trial, and that always in sympathetic co-operation with the family physician, who should do everything in his power to remove all depots of general systemic infection, be they in the bowels, the genito-urinary tract, or anywhere else in the body.

And now, let us look at our position frankly. Dentistry is and always has been a branch of medicine, in spite of all denials to the contrary, and until the dental colleges generally teach their students the laws governing bacterial infection and the consequences

of systemic bacterial invasion and the principles underlying its avoidance and cure, Dentistry must stand convicted of sanctioning procedures that are inconsistent with modern scientific knowledge. Bridge work is taught and sanctioned that cannot, from its nature, be cleansed. Band crowns are recommended that from their nature and difficulty of construction, in a large majority of cases, project into the gums and alveolus in such a way as to insure and perpetuate systemic invading infections. The average dentist is taught to polish the fillings where they show; they are urged to make them smooth and free from rough edges between the teeth; but are they taught that these rough edges may cause endocarditis, pernicious anemia, arthitris deformans, rheumatism, and many other diseases? Are the students of to-day taught that gum infection with all its consequences may come from a living infected pulp? Is the profession generally alive to the dangers lurking in the fact that in teeth having two or three canals, one canal may be dead and putrescent, while the others may be alive, thus concealing the perilous depot of infection? Has there ever been a method of brushing the teeth taught by the colleges—that really removed the bacterial plaques from the mouth? How many men in this room teach their patients how to brush the wisdom teeth so that they will really be clean? Have we not given our time to the evolution of mechanics and theories concerning a vague systemic responsibility for tooth and gum deterioration and have largely neglected the fundamental principle, that the essential factor in avoiding and curing mouth infection is to see that the mouth is capable of being kept clean and is kept clean? Do we teach the patient to keep it clean, to mechanically remove the bacterial masses before they become large enough to become depots of infection? Do we not depend too much on antiseptic washes, in spite of the established fact that an antiseptic mouth wash may destroy or inhibit the growth of a thin bacterial film, but it is useless in the presence of a bacterial mass?

Elementary as they are, these are questions that deal with the very existence of dentistry as a learned profession. Complex systemic problems of bacterial immunization are forcing themselves upon our attention, but Dentistry can never hope to solve them until we, as a body, accept and inculcate in our patients the little Jewish maiden's advice to Haman of, " Wash and be clean."

ANNUAL REPORT OF THE PRESIDENT TO THE FIRST DISTRICT DENTAL SOCIETY STATE OF NEW YORK

By Henry W. Gillett, D.M.D.

April 6, 1914.

Your President desires first to express his appreciation of the co-operation of the members of the Society, the Supervisor and officers of Sections, the Journal Committee and Editors, the Clinic Committee, and especially of the members of the Board of Directors, with his efforts to make the administrative year a successful and effective year in the progress of the Society.

In reviewing the work of the year, some of the activities of the Board of Directors which have not previously been brought to the attention of the Society will be first mentioned.

One of the first activities of the Board, inaugurated almost immediately after its organization, was to take up with the dental supply houses the question of the marking of their gold products, and particularly their gold solders, in such a manner as to give accurate indication of their value.

In the opinion of the Board the system so long pursued by supply houses of marking solder approximately two carats higher than its actual fineness was in itself well calculated to deceive, and the Board was credibly informed that solders four and five carats lower than the marking were not uncommon. The ordinary practice and standards were, to say the least, not in harmony with the National and State laws, and many instances of flagrant violations of the laws seemed evident.

It is fair to say that one manufacturer had already begun to practise the system of marking advocated by the Board before it took the matter up.

A circular letter was prepared by a sub-committee of the Board and, after receiving the approval of the Board, was sent to most of the manufacturers of dental golds in this section of the country.

With but few exceptions the suggestions met with the cordial approval of the manufacturers and they were found ready to co-operate with us. As was to be expected, the different

manufacturers had different ideas as to detail of procedure. Those of you who have observed their course, however, are familiar with the fact that all of the important manufacturers in this section of the country are now marking their gold solders and their containers for them, not only with the legend in use so many years, but with the actual fineness in thousandths, and some are adding the equivalent carat value. Those few manufacturers who are not doing this because of large stocks of envelopes already printed, are so wording their advertisements and guarantees as to give the essential information.

It is a regrettable fact that some of these same manufacturers, who have cordially approved of the ideas advanced by the Board, and who have energetically brought before the profession their claims for consideration because of the superior standard they maintain, also advertise in other quarters gold solder of different standards and lower values. So long as they mark them plainly and honestly the members of the profession who use these debased products can blame only themselves if unsatisfactory results follow.

It is believed by the Board that its work in this direction has been helpful in advancing the standards of honest dealing between the profession and its supply houses, and in preparing the way for better standards in this particular department of our professional work.

It has been necessary for the Board to have conferences with two members of the Society during the year concerning conduct considered prejudicial to the welfare of the profession and the Society.

One of these involved the distribution of advertising circulars and the other the marketing of a dentifrice in a manner calculated to discredit our professional standing.

By the expressions of regret and apology offered by the offending members and their promise to refrain from repetition of their offenses, both cases were brought to a happy termination without the need for bringing them before the Society.

A third case received some preliminary consideration, but in this instance it seemed inexpedient to pursue the inquiry beyond the preliminary stage. It involved consideration of the testimony

of a member in a suit for damages brought against a dentist by a patient. As a result of consideration of this case, it seems to your president not out of place to call to the attention of the members the fact that progress of our knowledge is placing upon us new and broader responsibilities.

The spirit of the times demands observance of individual responsibility in all quarters. Therefore, it is for us who aim to set the pace of professional progress in this section to remember that we can do this only by keeping step with scientific advance in our field.

Responsibility for disastrous consequences of foci of infection is knocking at our doors, and the need for placing ourselves in an impregnable position in this particular, cannot be too strongly emphasized.

This brings us naturally to the consideration of two of the activities of the Society, namely, its research work and its post-graduate sections. With regard to the research work, it will be of interest to you to know that, in addition to a continuance of the very interesting consideration of the etiology of dental caries at the hands of Professor Gies and his associates, there has been added this year a study of all the literature of that subject and the preparation of abstracts of all the essential contributions to the world's literature as it now stands on the subject of dental caries. It is expected that these abstracts will be published in a monograph which will be of great service to all future students and investigators of the subject.

The Supervisor of Sections and the chairmen of the respective sections will undoubtedly make detailed reports of their work, but it seems appropriate to note here the high value of the work done in the post-graduate sections. As regards direct benefit to those taking part in the work of the sections, they may safely be rated as of greater importance than any other branch of our Society activity. The number of our members who feel that they can disregard all the opportunities for progress presented by the different sections, is a matter of constant and growing surprise to the speaker. As the result of experience in the executive office, we would urge upon you all, both recent graduates and those who have grown gray in service, to utilize these opportunities.

Before dismissing the question of our research work, it is appropriate to report upon one of the personal activities of the president during the past year. Finding early in the winter that it would be some time before the Research Commission of the National Dental Association would get effectively to work in the raising of funds in this section, and finding that our own research fund needed building up, your president began a movement which has resulted in subscriptions of ten hundred and fifty dollars for that fund. Of these subscriptions a little over one-half have been paid in. The subscriptions were made by thirty members, fifteen of whom subscribed fifty dollars each. It was your president's intention in the beginning to continue this effort until every member had been given an opportunity to get on the honor roll in this way for whatever sum he felt interested to subscribe. The fact that it seemed impossible to get successful results in this line, except by personal interviews, and that the National Society's commission recently began to give evidence of activity in this quarter, caused your president to suspend the work at the point above reported. He had hoped to be able to join with a goodly number of you at this time in further subscriptions of fifty dollars each to the National Commission's fund, and he takes this opportunity to again urge upon you the vital importance of supporting to the utmost of your ability the efforts of that commission whenever its appeal is set before you.

Only a brief word is needed from your executive concerning the special meetings of the year. One of these dealt with the matter of endorsing the amendment of the State registration law calling for annual registration, and resulted in an apparently satisfactory conclusion on that point. At the other, you were given a notable opportunity to hear the message of Prof. Guido Fischer, of Hamburg, Germany, on local anesthesia, and to see a most interesting and epoch making demonstration of technic through the medium of the moving picture. In the estimate of your executive this meeting was notable in another way, namely, the manner in which the younger men came to the front, and the older practitioners were conspicuous by their absence.

It has been a great pleasure to the president to find that the young men are ready to do work for the Society, and the fact

that they are so ready gives him new courage to forecast its progress in coming years.

As a final word he urges upon you all, young and old, to put your shoulders to the wheel and unitedly support the incoming administration.

THE INTERIOR OF THE FORSYTH INFIRMARY

By S. E. Davenport, Jr., D.M.D.

A good deal has appeared from time to time in the pages of The Journal regarding the Forsyth Dental Infirmary, situated in The Fenway, Boston, Mass., and accordingly, the facts which follow will be confined principally to a brief description of the interior of the building.

First let me say, for the benefit of those who do not know, that this enormous Infirmary, which will probably be in full operation by the early autumn, will be supported by the interest from its endowment of two million dollars. Expense has not been spared in the construction and the result will be the most up-to-date dental infirmary in the world.

There will be no wood in the building, as the walls are constructed of terra cotta blocks covered by plaster, the doors are all of steel, the floors of marble, tile or linoleum, and the ceilings are made on the arch principle of Guestaveno tile, every room and corridor having a different pattern, though all are attractive.

Now let us turn to a study of the basement. There is the children's entrance on the eastern end, and just inside is the coat room, entirely constructed of metal and to be sterilized every night, where the children must leave their hats, coats, etc., before passing on into the waiting room.

The waiting room is to be a "thing of beauty and a joy forever" to the children who inhabit it from time to time. It is 45 feet by 30, and the walls are to be covered with panels of Delft tile, made especially in Holland, representing different scenes from Mother Goose, viz: The Dorchester Giant, Pied Piper, Rip Van Winkle and Golden Fleece. An aquarium will be in the center of this waiting room as a further interest for its young patrons. Rather an unusual situation exists, in that the hose can be turned on in this room without injury to anything..

Adjoining the waiting room are locker and reading rooms for the use of school nurses who may come with the children, and

also the sterilizing enclosure. Here 1,000 cases of instruments can be thoroughly sterilized at one time with dry heat. A dumb waiter will carry the sterilized instruments to the floors above, though an electric elevator will be installed in the building.

Besides the rooms spoken of, the basement of this massive structure provides a room for visiting dentists, with toilets, showers and lockers; another for the permanent staff and half-time men, with similar equipment; a social service room, a room for students who may take special work in the care of children under some member of the faculty of Harvard or Tufts, unpacking rooms, janitor's quarters, etc.

Below the basement is the boiler room, containing notably two 100-h.p. boilers and an electric plant which will furnish the power for the vacuum cleaners, electric fans, motors and lights.

Coming upstairs or in the elevator to the first or street floor, we find at the southwestern end of the building two extracting rooms, each with rinsing bowls in addition to the ordinary equipment. An interesting fact that should be stated here is that the nitrous oxide and oxygen for anesthesia is to come from large tanks in the basement through a system of pipes. It is hoped that this method will prove to be a distinct advantage to the operator and a saving of labor as well.

A surgical amphitheater is one of the prize spots of the building in every way. Here there will be a stereopticon that will show the field of operation on a screen. This is separated from the extracting rooms by ward rooms, with a regular nursing staff on duty, and recovery rooms. Adjoining the amphitheater on the other side are the rooms for minor surgical operations, while beyond these are an anesthesia room, an examination room, a consulting room, a sterilizing room (connected by a dumb waiter with the large sterilizing room in the basement), and a spacious lecture room, seating between two and three hundred people, for public lectures illustrated by a stereopticon.

At the western end of the Infirmary, across the corridor, one may see the beautifully equipped research laboratory, with a large built-in refrigerator as a special feature. Next in line is the Director's office, and next, just the other side of the massive main entrance to the building, is the social secretary's room. It

is in this latter that the telephone switchboard is to be placed; and it is interesting to know that all telephoning will be done according to the dictograph system, so that nowhere in the building will ear-pieces be needed, and the mouth-pieces will be of the flat type. The library and founders' or trustees' room complete an excellently arranged first floor.

Passing upstairs, one finds himself in the overwhelming operating infirmary, a space 168 feet long by 50 feet wide in the center, with a wing at each end that is 30 feet in width. This infirmary is to be equipped eventually with 110 dental chairs, though there will be but 64 at the start, while at every chair there will be, besides the usual conveniences, cold and tepid running water, and a connection for warm compressed air. The difference in the temperature of the water in use is made possible by the fact that there are five water systems in the building, viz., hot, cold, tepid, drinking and fire.

To return to the two wings referred to above. In one there is an examination room, where every patient will be examined before going into the operating infirmary, a waiting room which is connected by a separate staircase with the large waiting room in the basement and the X-ray department situated a half story above. The other wing encloses an orthodontia research room, an orthodontia laboratory and a plaster room.

This gives a brief outline of the interior of the Forsyth Dental Infirmary, the only institution of its kind in the world, and I regret that lack of space prevents a more complete description, as there are many small rooms and crannies that have not been mentioned.

But the Infirmary is a wonderful building and the work to be done is a wonderful work; just how wonderful may be partly estimated from the fact that it is expected that there will be facilities, when the machinery is in full operation, for taking care of from 800 to 1,000 children a day.

LOCAL ANESTHESIA: INFILTRATION AND CONDUCTIVE METHODS[1]

By Dr. K. H. Thoma,

Assistant in Dental Anatomy in Harvard Medical School; Assistant in Anesthesia in Harvard Dental School.

The public demands dental treatment with the least amount of pain, and it is for the dentist to find out how this can be accomplished.

It is evident that the apparatus and preparation ought to be as simple as possible. Also, we should be so equipped as to be able to prepare the solution and make the injection in a very short time.

I will first describe my apparatus. It consists of:

Two Fischer syringes; one mounted in a short hub with a 26 mm., the other in a long hub with a 45 mm. iridio-platinum needle. I prefer iridio-platinum needles because they simplify matters, in that they do not need to be boiled before use, can be used again, and therefore can always be mounted on the syringe ready for use. They do not break. If steel needles, which often show specks of rust and oxide, are used, one has to boil them and should only use them once.

1. One glass jar, filled with absolute alcohol, containing nickel-plated stand with syringes and porcelain cups.

2. One bottle double corked for physiological salt solution.

3. One small porcelain dissolving cup, graduated from 1 to 3 cc. and,

4. One large cup graduated up to 10 cc. These are used to measure and cook the solutions, to dissolve the tablets and fill the syringe.

5. One glass tray with cover to keep tablets and reserve needles.

6. Alcohol lamp.

Drugs.

For drugs I use:

1st. Physiological salt solution. Professor Braun recommends:

[1] Read before the Massachusetts Dental Society, May, 1913.

℞ Sodii chloridi 2.0
Acidi hydrochlorid. diluti............gtt. 1
Aquæ dist 300.0

I fill my bottle with this solution and boil it fifteen minutes.

2d. Novocain—L—Suprarenin synthetic hypodermic tablets E, made by Farbwerke-Hœchst & Co. They come in tubes and are sterile. The E tablets contain 0.02 gram novocain and 0.00005 gram L-Suprarenin synthetic.

Preparing of the Solution.

I take the porcelain cup and burn the alcohol out. Then fill it with physiological salt solution to the mark and boil this solution over the flame for a few minutes. Next, I add the tablets and draw the cup through the flame till they are dissolved. The syringe then is filled from the cup, and the needle sterilized in the flame. The strength of the solution can be altered. (1) One E tablet to one cc. Ph. Salt Solution gives a 2 per cent. solution with 0.00005 gram suprarenin to the cc. (2) Two tablets to 2½ cc. Ph. Salt Solution give a 1.6 per cent. solution.

Technic of Injection.

I will only describe the easiest injections and leave aside the more difficult ones for conductive anesthesia in the upper jaw. These, however, will be found sufficient to get anesthesia of any tooth in the mouth. For illustrations look up my more extensive article in the Items of Interest, 1913, No. 4, Vol. XXXV.

I. Anesthesia in the Maxilla.

The neurology of the maxilla is more complicated than in the mandibula. In the spheno-maxillary fissure the maxillary nerve divides into posterior palatal and infraorbital; the first enters the palatine canal and comes out through the larger palatine foramen, supplying the posterior part of the palate and the palatal part of the gum. The infraorbital nerve gives off two posterior alveolar branches, supplying the buccal part of the gum and the upper molars. The infraorbital proper passes along, giving off branches through the infraorbital foramen, supplying the outside of face and labial part of gum; the rest passes downward along the antrum, forming a plexus supplying bicuspids and incisors. The anterior superior alveolar branch emerges

from the incisive foramen and supplies the anterior part of the palate and the palatal part of the gum.

The alveolar process of the maxilla is very porous; although the number of pores is different over the different teeth, they are sufficient to allow us to use the infiltration method without exception.

The Infiltration Method.

This method depends upon diffusion of the solution through the pores of the bone, thus reaching the dental nerve before it enters the tooth.

a. Injection for Single-Rooted Teeth.

But one injection on the labial or buccal side respectively is required.

Technic.

Hold the lip or cheek away from the gum, and with a short cotton roll wipe all the mucus from the field of operation. Then with a little bit of cotton dipped in solution of iodine and aconite, equal parts, sterilize and anesthetize the part where the needle is to be inserted. In very sensitive patients I use phenol on a very small piece of cotton applied on the well-dried mucous membrane. The point of insertion is halfway between the gum margin and apex of the root. The needle, held like a writing pen, is pushed—opening directed toward the bone—down to the periosteum. A few drops are injected here. Thence go upward to reach a point just a little higher than the apex of the root. The injection must be made slowly and evenly, and, if correct, very little force is needed. In this manner we put the deposit of 1 to 1.5 cc. of a 1.5 per cent. solution just over the apex of the root, between mucous membrane and bone. The tissue should not turn white and the velum is hardly noticed, because the deposit of the solution is higher than the mucous fold of the cheek.

b. Injection for Multi-Rooted Teeth.

For first bicuspids and second molars, we need besides the buccal, a palatal injection for anesthesia of the palatal root. This injection is made somewhat differently.

Technic.

We insert the needle nearer the gingival margin, push it down parallel with the root and inject 0.25 cc. of the solution.

The anesthesia takes place in from five to eight minutes. Massage of the part will help quicken the process. The anesthesia lasts for one hour, and any dental operation can be performed on this tooth.

For surgical operations on and around the teeth, as extractions, amputation of roots, etc., we need anesthesia of the teeth as well as of the surrounding tissue. Therefore, we use in these cases, always, a palatal injection in addition to the buccal or labial one.

II. Anesthesia in the Mandibula.

In the mandible the nerve supply is simpler. The inferior alveolar nerve which supplies all the teeth enters the mandible through the mandibular foramen, and by a plexus supplies all the teeth of one side of the jaw. It anastomoses in front with the nerve of the opposite side.

A branch is given off which emerges from the mental foramen and supplies the anterior part of the gum and the lower lip.

The inferior alveolar nerve with the artery lies before, and when entering the mandibular foramen, in the pterygo-mandibular space. This is bounded externally by the sulcus mandibularis, internally by the internal pterygoid muscle. It is filled with connective tissue, which has a great absorbent quality. The nerve lies posterior to the artery.

The lingual part of the gum and the side of the tongue is supplied by the lingual nerve. The lingual nerve first accompanies the inferior alveolar nerve, then passes further forward and descends between the ramus and internal pterygoid muscle at its anterior margin. It then lies halfway between the surface of the oral mucous membrane and the inferior alveolar nerve.

The buccinator nerve supplies the buccal part of the gum. It is also a branch of the mandibular division of the fifth cranial nerve.

So much for the nerve supply in the mandible.

The bone in the mandible is much denser; but few pores

are seen at the necks of the teeth and in the mental fossa. Moreover, this condition varies greatly in different individuals, and therefore the infiltration method would be of varying success. Accordingly I use in the mandible, the conductive method exclusively.

Conductive Method.

The conductivity of the main trunk of the nerve supplying the teeth and tissues in the oral cavity is intercepted or blocked at a convenient point, while in mucous anesthesia the drug acts on the peripheral nerve endings. For solution I use 2 per cent. in accordance with Lieb's law, so that the concentration of the solution necessary to anesthetize a nerve shall be proportional with its calibre. It is especially practical when the mucous membrane is inflamed, spongy, or in any other pathological condition.

Pterygo-Mandibular Injection.

For the injection at the inf. mandibular foramen, palpate the postmolar triangle with tip of index finger on the left, with the tip of the thumb on the right side and with the other finger fixing the jaw. Prepare place of insertion as described above, place syringe (mounted with 42 mm. needle) between cuspid and first bicuspid of opposite side, and insert it in the mucous membrane 1 cm. over the last molar and try to feel with the needle the internal oblique line. Then slide it a little more medially and push it forward, keeping in close contact with the ramus. This may necessitate a different direction of the syringe according to the angle of the ramus to the median line which varies. After the insertion of the needle inject a small quantity. Then the needle is slid along the bone till it is inserted to its full extent, depositing 1.5 cc. of the solution into the pterygomandibular space, in which the alveolar nerve and vessels lie. Anesthesia occurs in 15 to 30 minutes.

Mental Injection.

For the injection into the mental foramen we insert the needle into the reflexion of the mucous membrane, below the first bicuspid, pushing down and slightly back along the bone for

several millimeters and depositing 1 cc., massaging it after the injection.

For extracting and surgical operations we need, besides the above-named injections, additional anesthesia of the soft tissues. That means anesthesia of the lingual and buccinator nerve.

Lingual Nerve.

We start as for the described mandibular injection. But, when the needle is half way in, we stop and deposit 0.5 cc. for anesthesia of the lingual nerve. The lingual nerve lies anterior and medially to the alveolar nerve, halfway between the alveolar nerve and the mucous membrane.

Then we proceed, emptying the rest of the contents of the syringe in the pterygo-mandibular space.

Anesthesia of the inferior alveolar and lingual nerve occurs in 15 to 20 minutes. The first signs of a good anesthesia occur soon, the patient feels numbness starting in the tip of the tongue and median line of lower lip.

The buccal part of the gum is not supplied by either of these nerves. Therefore, if we want to operate upon the area of the molars and bicuspids, we need to anesthetize this place.

Buccinator Injection.

For the buccinator nerve, I make one injection either directly into the mucous membrane supplied by it, or, in case of inflammation, by conductive anesthesia, inserting the needle just below Steno's duct.

REPORTS OF SOCIETY MEETINGS

MEETING OF ALLIED SOCIETIES OF BOSTON

December 17, 1913

Discussion on Dr. Head's Paper.[1]

Prof. Eugene H. Smith—I came here to-night, as a majority of you came here, prepared to listen, and not especially prepared to enter upon the discussion of this subject.

First I want to refer to something Dr. Leary has said which is full of truth, namely, that the attitude of the average student of the dental school toward medical subjects is not what it should be. Now, what is the reason for this? The chief fault is in the curriculum of our schools. There are a few schools, however, that start the dental student first on his medical education, and he knows absolutely nothing about the dental side of his specialty. I have always been made sad and chagrined when I have picked up a catalog or a syllabus of a course to freshmen in our dental schools and read that on the first Monday morning there was a clinic in crown and bridge work. You might just as well say to the first year men in medicine, "We will all go over to the hospital and amputate a leg."

Now, it is within the management of the schools, the executive officers of such schools, to change all this, and change it at once, if they only will.

I was pleased to have Dr. Head emphasize the systemic cause of pyorrhea, because we still have among our numbers a great many men who look upon pyorrhea alveolaris as a local infection pure and simple. Now, I have had in my practice many cases of pyorrhea alveolaris that I found would go about so far under the treatment known as instrumentation, and when I seemed to run up against a stone wall, I have called upon some of our best medical men to examine these cases and advise with me, and I have found in many instances that the patients had diabetes to such an extent as to prevent the proper cure of these cases, and when these diabetic cases have been taken in hand by the physician I have found these cases to be much improved.

[1] See Dr. Head's paper in full at p. 211, this number of THE JOURNAL.

I have been trying to systematize some action in regard to the value of vaccines by finding out whether it is the vaccine that cures pyorrhea or instrumentation.

I want to try vaccine therapy on these cases, if need be, but I want you first to use your skill with instruments, and if you cannot cure these cases, or they don't cure as we like to have them cured, I want to use vaccine. I have watched these cases week in and week out and Dr. Stanley seems to cure them with his instruments, when I have to call for the vaccine therapy help. Therefore I am a little bit doubtful myself as to the real value of vaccine, providing these pyorrhea cases have been properly treated by the use of instruments.

Dr. Edw. C. Briggs—It is a great privilege to have Dr. Head with us to-night. He could have addressed us on a hundred other subjects, but I think he chose one which is of immense interest to us, and although he alludes to it as a subject which we have studied and understood for a great many years, I think really it is very new. If you have listened carefully to Dr. Head and Dr. Leàry on this important matter, I can only emphasize what they have said, and that emphasis is in pointing out the many close relations between diseases of the mouth and systemic disorders. It is up to the physician, in making a diagnosis for treatment of his cases of septic arthritis, nephritis and many other diseases that I cannot mention at this moment, to realize that he has not covered the ground of investigation unless he investigates the mouth or oral cavity for sources of infection.

Now, I may not criticise Dr. Head, but I want to emphasize that pyorrhea does not mean Riggs' disease. We have pyorrhea from an impacted tooth, pyorrhea from an antrum, pyorrhea from any source, any cause in the mouth which has begun a series of infections to the general system, and the dentist of to-day cannot let his cases go by that have discharges of pus. In other words, if you have a patient who has an alveolar infection, the patient is absorbing poison into his system, and when such a condition exists he becomes a prey to any number of diseases.

The term "pyorrhea alveolaris" I have also taken exception to; I tried, in a paper in 1908, to designate it "interstitial gingivitis," but no one seems to understand the term, and I have there-

fore gone back to the old name of Riggs' disease as being the best until some one gives us a more scientific one.

Pyorrhea is pus flow, and we have pus flow from a great many other things besides Riggs' disease. Dr. Head has amplified his treatment with the bifluorid of ammonia and I think you have appreciated his technical description of its manufacture and use. I have used it and have regarded it as a very excellent help in time of trouble. It is one of many treatments. There is a new treatment introduced by Dr. W. F. Dunlop, which you have probably heard of recently and some of you perhaps have investigated, upon which I hope some day to make a report. It is not to be ignored.

I want to commend what Dr. Leary has said about the vaccine treatment, and I think he has presented and summed it up most excellently. It is a help under certain conditions, but it is never to be used without surgical treatment.

Dr. Ainsworth said that I was going to tell you of my success with Riggs' disease, but I think that is not to the point to-night. Riggs' disease can be helped in all cases, arrested in many cases, and it is for us all to keep on working along this line. These things do not come in a minute. We like to have everything go as a filling does—immediate results; and if we treat a case of Riggs' disease and the patient is not well the next time we see him, we think Riggs' disease cannot be cured. However, if you keep at it you will be quite satisfied with your results. You will not cure them all; neither are all cases of measles cured.

Prof. Charles F. Painter—I came here to-night very largely to be instructed in what constitutes a dental dean, and also to be introduced, as far as my capacity will allow, into some of the problems which are concerning your profession and my profession, because it seems to me that the medical profession and the dental profession are practically one in their aims. Certain it is, we are coming to realize that the problems which concern the two departments are many of them problems which must be solved in a broad way, largely because they concern themselves with general conditions. This is a sufficient indication that these two branches of medicine are being more and more intimately associated.

My particular line of medical work has led me into fields

in which septic conditions, particularly in connection with chronic arthritis, offer problems for the solution of which vaccine treatment has been thought to be necessary.

This condition of pyorrhea I cannot help, but I feel that as yet we are considerably in the dark as to what comes first, the systemic infection or the local condition in the mouth. We are not in a position, I think, to infer from any reported cases. In regard to chronic arthritis, where we are unquestionably dealing with an infection we can be reasonably assured as to the character of the infection in many instances, as well as to the focus in the body which is responsible for the local condition in the joints. These conditions in the mouth, of which we have been hearing to-night, are unquestionably in a certain proportion of cases—a small proportion, I believe—the cause of chronic systemic arthritic infections. There are enough instances in which there has been a very definite improvement or perhaps complete disappearance of the local arthritis, after treatment of the pyorrhea, to justify the belief that pyorrhea is a cause of arthritis. On the other hand, there are many cases of this character in which there are present these conditions in the mouth in a sufficiently severe form in which no benefit has accrued from the most careful, thorough and consistent treatment of local conditions in the mouth, and in which it has been impossible to find, upon investigation of other parts of the body, any possible source of infection to justify the supposition that they might be the cause. I am not saying this because I wish to disparage in any way that which has been said with relation to pyorrhea, but I think there is just ground for the belief that many of the pyorrheal disturbances are simply evidences of disease in other parts of the body, as, for instance, in the gastro-intestinal tract. It should be our work, as it should be your work, and as I understand from the very fact that you are discussing this subject here to-night, you regard it as part of your work, to find out whence are these sources of infection, and to eliminate, so far as you can, all local causes, but not to be discouraged or disheartened because you don't find the explanation of your local infection after you have given the proper attention to the various possible other sources of entrance.

The whole question of the relation of systemic disturb-

ances and infections to the sources from whence they come, will be a field for the activities of you gentlemen just as much as for the activities of the medical profession, and it seems to me that the careful and close attention which you gentlemen have given here to-night to the discussion of a subject which is not very new, which has been under discussion at your meetings for many years, is evidence that you are thoroughly aroused on the question and are sure to secure results through your persistence.

I think it is a great compliment to the reader of the evening and to the profession which you represent that you are willing to discuss so enthusiastically a subject which is so perennially served up to you.

Prof. C. A. Brackett—I am glad to testify my lively appreciation of the excellence of the paper which Dr. Head has read, and of the interest in the subject and the intelligent grasp of it which are manifest in the discussion. I believe that there is a wide range of relationship between disease in the mouth and disease in other regions and organs of the body, and that in the case of many of them, either may stand in a causative relation to the other. Able men recognized some of these relations many years ago. Dr. Horatio R. Storer was one of those men. He began his medical practice in Boston in 1855 and became one of the world's great pioneers in gynecology. The difference between the eminent man and the ordinary man lies often largely in the difference with which they look out for what are commonly considered little things—the importance which they attach to what may be influencing circumstances. Nearly a half century ago Dr. Storer was insisting that his patients should have their mouths put in order so that facts within the oral cavity should not continue to exert their harmful reflexes upon the pelvic organs.

It was my privilege to know Dr. Riggs intimately in the later years of his life. Naturally he was more inclined than are we of to-day to ascribe to the mechanical fact of calculus impinging upon the soft tissues the almost exclusive etiology of Riggs' disease; but he had a lively appreciation of the perniciousness of chronic suppuration in the mouth, and of the constantly flowing current of pus going into the stomach and poisoning nutrition at its source.

Dr. Riggs has had no more earnest and devoted disciple than my preceptor, Dr. L. C. Taylor, of Hartford. Dr. Taylor has been especially successful in his treatment by instrumentation of this infection, and he has many patients whose former serious condition with disorders of digestion and nutrition and with rheumatism has been put aside with no treatment other than setting up a state of health in the mouth.

In our student days we were taught the deplorable manifestations which might be made in the mouth through the injudicious use of mercurials in the treatment of systemic disease. Later we learned something of how some of the cases of mouth disease are consequent upon kidney disease. It is a more recent discovery, and I think not generally well known, that there are cases of kidney disease consequent upon chronic suppurative conditions in the mouth.

Some years ago I had on my office staff a young Scotch lady, Miss Alice Gertrude Harvie. Subsequently she graduated very honorably from the Philadelphia Dental College and married Mr. Max Duden, a German chemist, trained with all the thoroughness of the German university. Dr. Duden established a busy practice in Indianapolis as a specialist in oral hygiene. In her work, becoming familiar with many of the multifarious relationships between disease in the mouth and disease in other portions of the body, there came to her mind the question: "May it not be that chronic suppuration in the mouth stands in a causative relation to kidney disease?" Dr. Duden set about finding a competent answer to the question. For the investigation she enlisted the co-operation of her husband, the skilled chemist, and of the Indianapolis Medical Society, with the result that in six months, working together, they had made up a list of seventeen cases of kidney disease that had subsided in consequence of effective treatment of the mouth disease. Here is established truth which, as I said, I believe has not been fully and generally grasped. I am not putting it forward as universal law, but as one fact in connection with the subject under discussion.

During the summer and early autumn I spent much time and effort in the treatment and restoration of a number of teeth in the mouth of a lady. Several of the molars were badly broken

down, but I was anxious to save them on account of their being greatly needed for mastication. The lady had in Newport, a well-paid position as a trained social worker. She was very fond of her work and in it, was very successful. Our climate is one in which much rheumatism prevails, and in the autumn she acquired the disease in a very painful and disabling form. The patient was quite the reverse from being reconciled to this, and she resolved to be relieved of the trouble if any power on earth could accomplish it. Most regretfully she resigned her cherished position in Newport, came to Boston and put herself in the hands of able men, medical and dental. In the investigation of the case the X-ray was used about the teeth and jaws, and four teeth were condemned to extraction. Two of these were the molars upon which I had expended so much effort. They were shown to have blind abscesses. Of course other treatment was used. The result, doubtless of all the remedial agencies together, has been that the rheumatism, while not entirely cured, has been very greatly lessened. The pain has been nearly all gone for several weeks and the patient gets around with little difficulty, except in going up stairs. I suppose that a portion of this amelioration is fairly due to the elimination of suppurative processes which, while not superficially apparent, existed in the mouth; and I am convinced that the more we study such things as Dr. Head and the other speakers have put before us to-night, the better service we shall render suffering humanity.

Dr. Ned A. Stanley, New Bedford—The subject of interstitial gingivitis—Riggs' disease, pyorrhea alveolaris, or by whatever name it may be designated—will always be found to be a live wire, and the energetic activity of this doughty opponent is of such a nature that, after we think it has taken the count, it often comes back for another round, and finally gets the decision.

I was particularly interested in the paper of Dr. Head and the discussion of Dr. Leary, who laid great stress upon the importance of thorough surgery in the successful treatment.

This, in fact, is about the only treatment I use, and is what the case first demands and without which a restoration to function and comfort—a cure—need not be looked for. Vaccine therapy may be an adjunct to the treatment of instrumentation. but I have not found it necessary in my cases.

Any irritant that will destroy the integrity of the gingival margin may lead to pyorrhea. Within a week I have seen a case where a well defined pocket had developed from an unusual cause, on the labial surface of the upper left central. A year and a half or so ago the patient had a gold filling put in which extended slightly under the free margin of the gum. The rubber dam did not quite clear the edge of the cavity and was caught between it and the gold. Upon the removal of the dam a little piece was left under the gum, and was still there and somewhat elastic when I saw it.

We don't always find pus in every little pocket, though there is a destruction of tissue, but the treatment called for is the same. It is only a difference in degree, according to the stage of development.

And a mighty important function it is for the dentist to detect and treat this affection in its incipient stage, for if you realize what this leads to, you know it is the beginning of the end of that tooth—the foundation of the dental structure is being attacked.

The peridental membrane serves to attach the tooth to the socket, and any portion of the root denuded of this membrane loses that much support, since this tissue does not reproduce itself. I take it then, a cure means to arrest the progress of the affection and preserve as much of the membrane in a healthy condition as possible.

And this leads me to ask the essayist, through what medium the extraordinary phenomenon of the peridental membrane reattaching itself to the root surface takes place?

Dr. M. C. Smith—I am proud of the fact that I belong to the dental profession, and can look back with pleasure on what we have accomplished and the stimulus we have given the medical profession during the last twenty-five years. Many of the men of the dental profession realize the importance of infections from the mouth, and have done much to clean out the oral cavity. I will refer to just one condition, and that is enlarged glands of the neck. While our medical brothers are wont to call it tubercular adentitis and give a very grave prognosis, we call it infection from the mouth and feel that it can be cleared up with due attention to the oral cavity. I am fully convinced that 90

per cent. of all enlarged glands of the neck are due primarily or secondarily to infection in the mouth or jaws. I see much less infection in the neck now than I did years ago, and attribute it to the improved condition of the mouth. To-day, if any of my small patients have enlarged glands of the neck I feel that I am to blame; it is my fault, for I have not kept their mouths in proper condition.

I am a firm believer in vaccines and am using them constantly with satisfactory results, but realize with vaccines we are working in the dark. While the men in Europe and in the South have found the staphyloccocus and the streptococcus to be the predominant micro-organisms in pyorrhea alveolaris, we, here in New England, have found pneumococci to predominate. Why this difference? Even at best we know that the infections that we are able to get from pyorrhea cases are only secondary infections, and possibly they are acting as scavengers at that. We cannot expect much success with vaccine therapy until we have found the primary infection, whatever it may be, whether slow-growing bacteria or some undiscovered micro-organism. Personally I am inclined to think it will be treponema.

There is one point in the paper that I would like to refer to; that is that the essayist, in getting his cultures in pyorrhea alveolaris, went below the infection of the pyorrhea alveolaris and got into the alveolar abscess cavity. He therefore got the infection of the alveolar abscess instead of the pyorrhea infection, and consequently got a different infection, which should contain more staphylococci and streptococci than cultures from pyorrhea pockets. That may account for the different findings between here and elsewhere. For the treatment of pyorrhea with vaccines I depend upon the pneumococci as the curative agent.

There is one feature in the great movement of oral hygiene which I do not like, and that comes from the medical men. They are altogether too prone to carry a case along with little or no improvement until the patient is tired out, and then tell them that it all comes from the mouth, no matter what the disease may be. They then tell the patient to go to the dentist, that that it is up to him to cure them, and they all think it very strange if he fails to do it. They are trying to make us the scapegoat of the medical profession.

FIRST DISTRICT DENTAL SOCIETY, STATE OF NEW YORK

February 2, 1914.

A regular meeting of the First District Dental Society of the State of New York was held at the Academy of Medicine, No. 17 West Forty-third Street, New York, on Monday evening, February 2, 1914.

The president, Dr. Henry W. Gillett, occupied the chair, and called the meeting to order.

Dr. Thomas B. Hartzell, of Minneapolis, read the paper of the evening, entitled " Secondary Infections Which Have Their Primary Origin in the Oral Cavity." [1]

Discussion on Dr. Hartzell's Paper.

Dr. Robert T. Morris, New York City—One must be impressed through this addition to preventive medicine, by the fact that all branches of medicine form a sort of interlocking directorate, and the time has come, I believe, when the dentist must first graduate in medicine. The reason for that is, because when this enormous amount of new work is being done, we are apt to lose our sense of relative values. The important thing is to keep the sense of proportion in regard to the relative importance of a series of symptoms occurring in connection with any pathological event.

In the course of development of any cultural period, we have first the era of superstition, then the era of analysis, and following that the era of synthesis. We are now in the midst of the era of analysis, when numbers of men are developing vast aggregations of facts, but these facts are parallel, and are not carried through a lens at the present time for focusing upon great principles. That is the important thing. We all must get together—dentists, surgeons, internists, upon some common ground which will allow us to apply synthesis to available facts like these brought up this evening.

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[1] See Dr. Hartzell's paper in full at p. 166 of the present number of THE JOURNAL.

I was very much impressed by that point of the transmutation of bacteria; and the way in which Dr. Hartzell has presented it makes it of very great value. The germs about tooth roots are subjected to conditions of varying pressure. At such times we get a greater degree of transmutation than is likely to occur anywhere else in the body.

Bacteria are simple growths, morphologically, but highly organized chemically, because in the course of evolution they had to become the peers of the body cells. They are the hereditary enemies of the body cells, consequently the attacking party. The microbe, as destructive unit, and the body cell as constructive unit, have been in constant warfare. They have maintained a fairly good balance age after age, but in the course of decline of any race, when we are running out of our protoplasmic energy, the bacterium is forging ahead, and under the conditions described by Dr. Hartzell undoubtedly transmutation occurs rapidly, and a species of bacterium is not a morphologic entity, it divides by fission. Cells which divide by mitosis retain their character more persistently.

We have recently learned that scurvy proceeds from mouth bacteria. The captain and the mate, who brush their teeth, may not have scurvy, while all the rest of the crew may succumb to it. No doubt the protein poison which gives the marked response of scurvy, causes an allergic process.

In regard to dyspepsia and ulcer of the stomach, being due to mouth conditions, that is a place in which we are likely to go astray and lose our sense of relative values. Dr. Lane, of London, tells us that all these cases proceed from toxins from the colon. He has stepped into a large new field of fact and lost his sense of relative values.

Dr. Gould tells us that they proceed from eye-strain. Dr. Gould has stepped into such a large field that he also has lost his sense of relative values.

You who have heard these important new theories of Dr. Hartzell must try to keep your sense of proportion. There are cases in which toxins from the teeth no doubt lead to dyspepsia and gastric ulcer. What is gastric ulcer? Let me answer that in my own way. A number of small branches of enteral arteries

are terminal. Because toxins are thrown off at this point by selective action of this part of the enteron, in the course of their excretion, the endothelium of vessels is injured. Exudate blocks the terminal vessels, and then you have a small anemic area. This small anemic area is then vulnerable to bacteria and to digestive processes. You may have the same thing caused by toxins from the colon, or the same thing caused by the protein product of a burn of the first degree, no bigger than a dollar, on the abdomen. We may have ulcer of the stomach produced by three as widely separated processes as these.

Just mark that well. Do not tell the next patient who comes into your office with ulcer of the stomach, that you are going to cure him by caring for his abscess pockets. Treat pyorrhea pockets; but do not tell the patient that you are going to cure him of his ulcer of the stomach. There is possibly one chance in twenty that you will, and the rest of us surgeons are culpable if we do not recognize that possibility. It is a matter for analysis and synthesis when we all join in common knowledge of the same grand profession.

One point more, in regard to the use of strong iodin and the cautery. That is a point to which the surgeon would naturally make objection.

If a skilled technician like Dr. Hartzell finds in actual practise that such is a desirable procedure, well and good; but theoretically from a biologic standpoint the body cell must meet the bacterium. The body cell disabled by the cautery or any germicide is not able to meet the bacterium. You destroy the bacteria there for the moment, but within forty-eight hours the disabled body cells are attacked anew by other bacteria. That is the surgical standpoint which we find brought into opposition to the idea of using means which disable body cell when destroying bacteria.

The persistence of supply, Dr. Hartzell said, breaks down immunity. That is opposed to our idea in general. The accepted idea is that the more warriors you have the bigger army you bring out in response. The natural tendency of all disease is toward recovery. The more disease you have, the longer continued, so much greater the tendency toward recovery through

the help of antibodies. That would be opposed to the theory which Dr. Hartzell has brought forward. The mouth is one of the protected areas of the body. We get primary union in almost all our operative work above the mouth because of the presence of special leucocytosis in this region. You will have primary union in operations about the mouth and anus which is quite remarkable, for the reason that these are protected areas due to the persistence of supply of bacteria which do not break down immunity, but which make it notably strong.

Dr. Nathaniel B. Potter, New York City—I feel the same humility in discussing this paper before your Society that I did when I was a first-year medical student and read a thesis in physiology to the professor.

This is a subject which has interested me profoundly for a number of years, and I think that its very great importance in all departments of internal medicine is only beginning to be recognized. I greatly appreciate the opportunity of having heard so interesting, profitable, and stimulating a paper as Dr. Hartzell has given us to-night.

A few points have occurred to me while following cases of dental sepsis, in connection with my colleagues in your specialty: During the last two years I have been making an effort to find out if we could determine whether joint affections, kidney or some other medical diseases, depend upon a streptococcus infection, be it of the teeth roots, the tonsils, or elsewhere. I have been in hopes that a test similar to the gonococcus fixation test or to the Wasserman test could be used to determine the existence of active streptococcus infection. With the assistance of Dr. McNeil and his co-workers at the New York City Health Department we have been making a series of tests upon patients of urine affected with dental or tonsillar infection; we have done something over one hundred cases in the last year, and thus far the results have not been very satisfactory.

Cases in which I have found either viridans, hemolyticus, or pneumococcus, in the tonsils or the teeth roots have shown sometimes a negative and sometimes a positive reaction. There has, however, been a glimmer of correspondence which has led us to continue, and we have not fully decided whether this reaction

may prove to be of some help or not; so that I think that the clinician in making his original examination of his patient, is bound to turn the patient over to one of you gentlemen, and insist upon putting the brunt of the diagnosis, as well as the treatment, upon your shoulders.

Even careful radiographs interpreted by the X-ray specialist, by the dentist, and by myself, to prove the existence of an abscess cavity at the root of a tooth, have sometimes been at fault and been responsible for an unnecessary removal of a tooth. In other cases I have found a tiny abscess cavity containing a pure culture of hemolyticus or viridans responsible for the patient's symptoms, and yet several excellent plates did not show its existence. I believe, therefore, that just as in most departments of medicine, no one test, be it bacteriological X-ray, or even the careful observation upon the part of the clinician and dental specialist, alone is going to be sufficient to solve this problem in all cases. The hope that we may find some further suggestive tests is still very keen in my own mind.

If we take cultures of the gums, of teeth roots, or of channels into abscess cavities, we will almost always get virulent streptococcus viridans from the cultures; but even in relatively pure culture they are not always the cause of any infection.

In the last two years we have made a very large number of cultures in cases of dental sepsis, and in a great many other cases, and it is rare not to recover a streptococcus which makes a green tinge; in other words, a streptococci viridans from such a culture, even when there is no apparent dental sepsis. Those are some of the difficulties which occurred to me.

I heartily join with you all to commend and praise the extraordinarily valuable work which Dr. Rosenow has made recently. I am in hopes that Dr. Rosenow will now clinch the work he has just brought out and publish his methods, so that he may get the credit which he deserves for this wonderfully patient, careful investigation.

Dr. Morris just spoke of infection as being capable of bringing out a rather large army of defense. There is one point I have noticed—one frequently finds that a series of infections follow a very severe disease. Your reader to-night mentioned a case

following typhoid fever. Two of the worst cases of oral sepsis which I have seen, dated the first onset of their tooth trouble from a severe attack of typhoid fever. I have noted a similar sequence in a number of other infections, especially of staphylococcus infection, and I think there is a certain amount of immunity which the individual can contribute to fight against infection, but overwhelmed by some severe disease, the immunity response becomes incapable of further stimulation and the fight is lost. The first weak place, be it a dental cavity, tooth root, or what not, is attacked; then comes the long chronic case of infection such as Wright has described, and such as the reader has just described to us in his case following typhoid fever.

These are the cases which it seems to me the dental surgeons sometimes leave too long before they remove the teeth. I am fully in accord with all of you in trying to save and preserve and do good surgery on these septic conditions, but I have seen in the last four years two cases where the teeth were allowed to stay too long, and where only complete removal of the teeth enabled the disease to be arrested. It is a very nice discrimination to know where that point comes, but many of you who are thoroughly conversant with preventive measures will be able to eradicate the disease before this point is reached.

I had the opportunity of discussing a paper before this Society some years ago in connection with vaccine therapy, and I think I made the same statement which I will make now, that I have yet to see a case of dental sepsis in which any form of vaccine therapy was equal to real good dental surgery, although I know it helps in some cases.

I was especially interested in your reader's description of his attempts at excessive treatment on the two cases which he related.

To my mind that was a very illuminating lesson. It had already occurred to me in connection with two of my patients in which the brilliant surgery performed by my dental colleagues had been so severe and so thorough that it had been far too much for the patient's health. The reader's reasons are so evident that it is hardly worth while touching upon it again, but I sincerely hope that they interested you all as keenly as they did me.

I want to thank you again for the opportunity of speaking, and especially for the opportunity of listening to so interesting and profitable a lecture as we have had this evening.

Dr. Byron C. Darling, New York City—The subject which has been so ably presented here to-night has been one of great interest to me, but I feel that it would hardly behoove me to attempt to add anything to the paper as read, and the discussion which you have heard. With the chairman's permission, I would like to show a few Roentgenographs I have made, chiefly of cases of arthritis, several of which came to the Hospital for Ruptured and Crippled.

Those cases of arthritis whose oral cavity condition you have seen by the pictures on the screen, are very sad cases, and are worthy of every means being taken to give them relief. Now, the focus of infection must be found, and whether it is the teeth or not, every good physician and every good dentist must try to eradicate any foci in the teeth.

The following lantern slides were shown:

(1) Mr. K.—This was a case of a young man who had shown no particular symptoms except a discharging fistula from this pus pocket which you see. Note the pivot crowned tooth without having had the root filled to the apex. How long will the patient's power of resistance hold the infection in abeyance?

(2) Slides a and b. This is the case of a gentleman who might be briefly described by the term of "neurasthenic," although he has a certain number of symptoms which might point to an ulcer of the bowel. (a). Note pus pocket. (b). Here is what I take to be the beginning of a pocket; here this root has been filled: and here this has evidently not been filled to the apex. Note also the absorption of the aveolar process from pyorrhea.

(3) This was a case of general arthritis of long standing, and in the arthritis cases I am showing, in every case the tooth condition antedated the joint condition. The slide does not show the extent of the pus pocket, but it was evident in the original film and showed a pocket around the roots of this and the adjacent middle incisor.

(4) This patient had been sick for a long time. The condition was evidently of a septic nature and the diagnosis was made of septic endocarditis from which she finally died. No other focus could be found than this necrotic molar.

(5) Mr. H. A. I.—This is a patient whose back is rigid, who has a multiple arthritis. He is a robust, strong man, but steadily incapacitated from his work on the police force. Note the aveolar abscesses about the roots which have not been filled.

(6) Miss B.—This patient for years has had multiple arthritis of very low grade, growing worse at times. She shows this excessive result of pyorrhea, with absorption of the aveolar process and probably the X-ray only shows a part of the condition.

Fig. 1

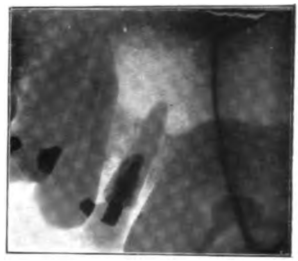

Fig. 1

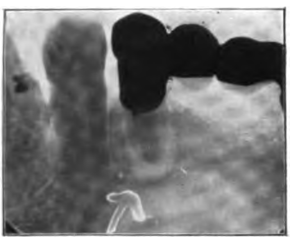

Fig. 2 (a)

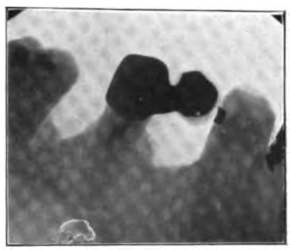

Fig. 2 (b)

Fig. 3

Fig. 4

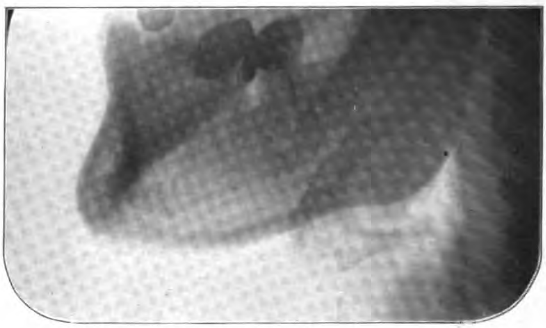

Fig. 5

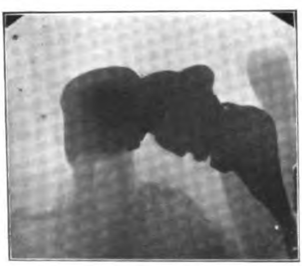

Fig. 6

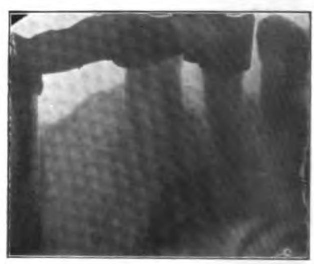

Fig. 6

Dr. Morris I. Schamberg, New York City—The subject under discussion this evening is one in which I have more than a passing interest. Indeed, I find myself tugging at my own coat-tails in an effort to maintain a temperate attitude whenever and wherever the topic is formally or casually brought up.

Seventeen years ago, shortly after acquiring the dental degree, I began to interest myself in the surgical eradication of infective foci found about the mouth. I was considered radical in my ideas, for that sort of work was not done to any great extent at that time, though root amputation and similar operations had been performed and were written about long before.

From the very beginning of the work, I was impressed with the tremendous bearing that diseased areas in the mouth have upon the general health, and I recall distinctly the manner in which a prominent teacher of physiology in one of the Philadelphia dental colleges, at a lecture that I gave before the State Society, endeavored to put a damper upon my views by stating that he had to his own knowledge in his mouth several abscesses which periodically discharged, yet he was a robust man—and few men in the room could boast of better health. I replied at the time that he was, indeed, fortunate in having a constitution that had thus far rendered him immune to secondary disorders. To-day no first-class dentist would countenance the retention in the mouth of a so-called "gum boil."

The results of the work of Rosenow, Flexner and other scientists of to-day clearly indicate to us that it is not only a question of the environment of the "bug" nor the susceptibility of the host, but that in the individual organism itself we may find a career as varied and as startling as in the vaccillating character of Dr. Jekyll and Mr. Hyde. A benign organism in the mouth to-day may to-morrow exhibit highly virulent qualities.

Clinical results are at least highly suggestive, if they are not conclusive. As proofs of our convictions, I desire to make a rather broad statement to the effect that I know of few operations in general or special surgery that so frequently bring about a transformation in the patient's health as the complete eradication of suppurative areas from about diseased teeth.

In the vast majority of instances, the patient, the dentist and the family physician are all unaware of the presence of the diseased area in the mouth until either an acute local outbreak is experienced or through the medium of a radiograph, the diseased area in the bone is revealed.

In other instances, the part may have been a troublesome area, but not having been studied with the X-ray, the extent of the lesion was never suspected, nor did any one associate it with systemic disturbances.

I have had hundreds of these patients sent to me for operations with a view mainly to clearing up the local condition. In almost all of these cases, the value of the cure locally was insignificant to the improvement in the general health, even though the patient had never complained of any definite constitutional illness.

My experiences undoubtedly conform with those of the essayist and with other men working in this field. Among the various secondary disturbances having their primary origin in oral infections, I would class septicemia and pyemia first. That secondary abscesses may thus occur in almost any remote part of the body, goes without saying.

Septicemia and pyemia, as a rule; arise from acute infections, and may, as is occasionally the case, result fatally in a brief time. I recall such a case in my own practice in which the infection assumed the proportions of a Ludwig's Angina in a patient that I was called to see when he was practically moribund as a result of infection starting about an impacted third molar.

Neglected infections of this character result fatally with comparative frequence. That the tonsil and throat frequently become infected from the mouth requires no stretch of the imagination. The maxillary sinus, the nasal chamber, the glands of the neck and other parts are frequently the seat of secondary infections. These facts are too evident to most of us to require any further discussion or elaboration.

I had one case of general furunculosis clinically attributable to mouth infection.

Several cases of acne cleared up wonderfully after removal of infection from the mouth, though no other form of treatment was instituted.

I have likewise had patients under my care with diabetes and Bright's disease, which conditions materially improved in the clearing up of suppurative areas from the mouth.

Rheumatoid arthritis, I believe, frequently is the result of infections emanating primarily from the mouth. I have had several cases of this character in which we were able to collect rather conclusive evidence substantiating our opinion.

If these facts are true, it is not unreasonable to suppose that lesions upon the heart valves occur with greater frequency than most of us suppose from what heretofore were looked upon as comparatively harmless infections about the teeth.

Only recently I detected in a patient who totally unsuspected any involvement of her heart that she had a lesion there which had not as yet through subjective symptoms manifested itself. This examination was prompted through the fact that the patient had in her mouth an abscess of ten or twelve years' standing.

Dr. Bernard F. Shea, Brooklyn, N. Y.—I have gone over the paper several times, and each time some new thought has occurred to me. Now, is it a fact that the dental profession is not doing its duty? I cannot agree with the essayist and the medical men in this. The dental profession has been trying hard for the past twenty years or more to prove that the diseased conditions of the mouth have a great influence upon the health of the body in general. We may not be familiar with all the bacteria present in the mouth, but we do know they exist in large numbers, and that they are responsible for many diseased conditions that fill the mouth with pus, and we know that whenever pus is present in the body it should be removed if possible and recurrence prevented. Now, this brings before all the thought of prevention, and the more I think of prevention the more I realize what oral hygiene means, and the sooner the medical profession realizes the importance of this subject (oral hygiene), the greater will be the benefits to the public.

I believe there are many ways that disease of the oral cavity may be transmitted, which could be prevented. For example, on a car the other day I asked for a transfer, the conductor, after moistening his finger with saliva, tore off a transfer ticket and handed it to me. Now, gentlemen, this man had a peculiar

skin condition, what it was I do not know, I was not in a position to make a diagnosis, but is it not possible to transmit a very serious disease in this way? Then, again, I have seen women get into the car, open a large handbag, take from it a purse, and from this take their fare, place it in the mouth, so that they may close the pocketbook, replace it in the handbag, and close that, then pay their fare to the conductor with this piece of money from the mouth. The conductor handles this, and mixes it with other money in his pocket. Now, is it not possible to transfer disease in this way? As I said before, the dental profession has been trying to get the medical men to realize the importance of the diseases that exist in the mouth. The family physician, with the absolute confidence of his patients, is the man that could do a great amount of good along this line. How many physicians examine their patients' mouths to see anything beyond the end of the tongue? Some of the leading surgeons of this country have of late years discovered that there may be reason to believe that diseased conditions of the oral cavity have some bearing upon the general health of the patient.

Dr. M. L. Rhein—The members of the section in pathology will recognize the fact that Dr. Hartzell reiterated to-night the bacteriological facts that have been brought before the section. When this is possible it augurs at least, hope of the possibility in the future of standardizing our therapy.

Dr. Morris made a strong point in taking up the question of the necessary technique for obtaining cultures. The utmost care must be used here in order to be certain that no contamination of some other germ has not occurred. Of course, when it is a case of tooth extraction, the technique becomes simplified.

The Roentgengrams shown by Dr. Darling should be published far and wide as specimens of dental malpractice. We know that this has been the character of service which most dentists turn out.

Speaking of dental services at our dispensaries, Dr. Lefevre in this hall a few weeks ago made the striking comment that he frequently found there poor patients worse off after having received dental treatment than they were at the outset. When we look at Dr. Darling's exhibit this does not surprise us. A

limited number of dentists during the past twenty-five years have tried to quicken the dental pulse in regard to this stigma in our practice. As a result we have been called everything, from alarmists down. Most of us by means of our agitations have succeeded in making ourselves the most unpopular of our profession.

The dawn of a new era is upon us, brought about by the fact that the bacteriologic work of the medical men has brought them to the dental tissues as the abiding place of many infectious foci.

The pathological investigations in reference to infections have brought the physician, as I said, to the dental tissues, concerning which the medical curriculum teaches them absolutely nothing. This is the present-day crime of medicine which must be remedied. The young doctor enters practice entirely ignorant of this part of the body. In no class of people do we find as many cases of septic dentistry as in the mouths of physicians. It is easy to understand why this is so. How can they properly advise their patients when they permit themselves to be poisoned in this way?

If I may say a word for Dr. Hartzell, he did not mean to imply that in all these diseases which he has described that they could all be cured in this way, or that they were all of dental origin. It always is necessary to have it understood that we throughly recognize the fact that there are other etiologic tissues besides the jaw and that each case must be diagnosed by itself.

At the regular meeting of the New York Academy of Medicine to be held in this hall next Thursday this subject will be discussed. This is the first time in the history of the Academy that a meeting has been given over to our field. It is a step in progress, and we can only hope that it will usher in the dawn of a new era where the physician will know something about dental tissues, and the dentist will understand more about pathology of the entire body.

Dr. Howard T. Stewart, New York City—Some thirty years ago, the great preacher, Sam Jones, of Georgia, was holding a revival meeting in the city of Memphis, Tenn., and he tells this story about himself: He sought in the early days of his evangel-

ical career to impress the most intellectual of his hearers, and he preached just as learned a sermon upon as learned things as he knew how to do. When he got through, he congratulated himself, and as he passed down the aisle all his friends congratulated him, and told him he had preached a magnificent sermon. As he got to the door, an old negro man came to him, and in that familiar way that the old-time negro has when he wants to be especially friendly, said: "Mas Sam, I wants to talk to you about dat sermon of yours." Mr. Jones said, "All right, Ben, go ahead." "Mas Sam, dat was a fine sermon; dat sho wuz a fine sermon," Ben said, and then did not say any more.

Mr. Jones was familiar with the negro character, and he knew that that was not what Ben intended to say, and he told him he could say whatever he liked, and need not be afraid of hurting his feelings.

So he said, "Mas Sam, you put your fodder too high. You put dat fodder where there couldn't nuthin' but the big cattle git it. The scrub cattle couldn't reach it at all. Dat sho wuz a fine sermon; it wuz all right for de big white folks, but de po' white folks and niggers didn't know what you wuz talkin' about." And so some of us find ourselves to-night among the scrub cattle.

There is nothing the matter with the fodder that was given us to-night, but it was a little high. Dr. Hartzell certainly succeeded, not only in bringing us the subject matter in a very attractive form, but he has given it to us in such language as we can understand, and he is to be congratulated.

I wish we had a hundred such men working along the same lines as Dr. Hartzell, and in just as earnest a manner as he is doing; and, if we had them, the next five or ten years would see a wonderful change in the treatment of the mouth.

There is one thing I want to speak about from a practical standpoint, in regard to the effect of micro-organisms upon the human system. To those who know almost nothing about this, I would recommend a series of articles written by Dr. Nodine, which are very simple, and have been given in exceedingly clear language. He seems to have done a great amount of compilation, and to have the peculiar turn of eliminating the chaff from the wheat, and giving us the kernel.

Just one thought in regard to elimination, which I consider so important for us all who pretend to treat diseases of the mouth. I think the day is fast coming when the man who treats these diseases of the mouth, especially Riggs' disease and pyorrheal conditions, must enter more fully the domain of medicine.

Vignal has told us, that man is born with the intestinal tract free from bacteria; that he soon begins to become invaded by the micro-organisms, and the adult male easily passes in the feces thirty to fifty billions of bacteria a day. Some of our best medical writers hold to the view that ninety per cent. of all sickness, exclusive of infectious diseases, is caused by auto-intoxication of the intestinal canals. I simply wish to call attention to that one thing, that we must control elimination by the intestinal canal in the treatment of these conditions, and also pyorrheal conditions, if we wish to be in the highest degree successful.

Dr. Alonzo M. Nodine, New York City—Dr. Hartzell's paper has for each of us its peculiar and particular interest, and for me, its importance lies in calling our attention to the fact that the micro-organisms which grow on the surface of the mucous membrane are subjected to a high oxygen tension or supply. As they penetrate deeper they are deprived of more and more oxygen until they reach the deepest tissues of the mouth and the bone, where they are deprived of a still greater amount of oxygen. Every time the amount of oxygen is changed, the virulency of the micro-organism is changed.

This phenomenon may explain for us several mysteries that are found in the mouth. For example, it may explain why there may be one kind of infection produced by the micro-organism living on the surface of a wound, another kind of infection from the micro-organism living at a lower stratum of the wound or pathological condition, and from a still lower stratrum the micro-organism may cause another disease.

Poynton and Pain in the introduction to their recent book on "Researches in Rheumatic Fever" call attention to several conditions for which the infection of the streptococcus rheumaticus may probably be responsible; for example a bronchopneumonia, a nephritis, a peritonitis, or an appendicitis. And while they say in this introduction that they have not come to

any final conclusions in regard to what is the responsibility of mouth infections for rheumatic fever, they state that this phase of the subject probably will be the next thing that they will investigate. When these two men take under observation a condition or a problem in pathology we can believe it will be carried to the ultimate extreme.

In regard to the virulency of mouth infections, we have illustrations of their increase by the method of passage from one person to another in one or two interesting cases reported by Dr. Griffith, of Swansea, England. In one a young girl tried to commit suicide. When the surgeon was attempting to put the tube of the stomach pump down the girl's esophagus she bit him. The surgeon died in forty-eight hours from the infection, and the girl recovered.

Griffith himself was infected by treating the socket of an extracted tooth. The girl recovered, and four years later Griffith was still suffering from the infection. In his article he also mentions a number of other cases in which similar results were noticed.

I have records of hundreds of cases culled from British and American magazines which indicate that the septic mouth is a very potent cause of systemic infection.

When physicians and surgeons say that we attribute all systemic infections to septic conditions of the mouth when we call attention to such cases as that, they draw their conclusions too fine.

Dr. L. C. Le Roy, New York City—Dr. Hartzell has given us a remarkably interesting paper, the gist of which seems to indicate that it is going to revolutionize the study of bacteriology; not only from a dental standpoint, but from any other. It is so important that, although others have referred to it, I cannot refrain from saying a word in praise of his work.

It seems logical to presume that oral hygiene is likely to solve some of the problems of preventive medicine. That has been said before, and it seems that every new thing that is presented to us only corroborates this theory or this idea; we will undoubtedly have an opportunity to elaborate much more on that as time goes on.

The oral cavity we have come to regard as the most prolific cause for most of the disabilities that take place in the human system. It is practically a truism, that organic infection does not take place until the resistance of the individual has been broken down.

Dr. Morris was right in some respects, but he made an error in reference to the wounds healing by first intention. A wound in the mouth does heal more rapidly by first intention; but he failed to take into consideration the degenerative conditions of the tissues immediately surrounding tooth sockets.

The thought occurred to me while the discussion was in progress, and I wish they could see the importance of it, that the time is coming when no surgical operation of any kind will be permitted, particularly the opening of the abdominal cavity, without oral prophylaxis having first been instituted.

Dr. R. G. Hutchinson, Jr., New York City—I want to express my appreciation of the paper Dr. Hartzell has given to-night. Certainly it is a most thorough and complete exposition of the subject; every word is logical, and logic must be truth—you cannot get away from it. Dr. Hartzell's statements are statements of fact, supported by clinical demonstration, and I have had experiences that coincide with his, and are corroborative.

I believe that great progress is going to be made in our own profession through just such papers as that which has been presented to-night.

Dr. Hartzell—Dr. Le Roy spoke of cleansing the mouth before surgical operations. It is a dangerous proposition to do that at the time of an operation, unless it is done long enough in advance for the patient to have overcome the toxins absorbed as a result of the cleansing process.

Therefore, I do not advise anybody to have mouth work done at that time. Such work should be done at least a month before heavy surgical operations are undertaken. If it cannot be done at least a month or three weeks before, do not do it at all.

Dr. Le Roy—I mean prophylactic work.

Dr. Hartzell—Some surgeons will not even have the mouths of their patients cleansed, though personally I think ordinary prophylactic measures are advisable.

In regard to what Dr. Morris said about the constant absorption of toxins building up immunity, I would differ—there is no question but that immunity is broken down by a constant, steady supply of a certain poison. Note the man that takes morphine. He eventually goes to pieces.

I am not a friend of vaccines, and these vaccines I have been using have been used for experimental purposes, principally because the vaccine offered an opportunity to get some collateral evidence as to the pathogenicity of the infections in question.

In regard to vaccines, I believe if you take an organism from a case in which you have reason to believe the organism is pathogenic; for example, a joint infection of great chronicity, and make the vaccine immediately, suppose you get a pure culture within a few hours, frequently that vaccine will not be of value because after the organisms have been growing in the patient's own blood for a great length of time, they become what I term serum fast, and if the organism which you recover out of your culture is grown for successive generations, it regains some of its lost power to combine with cell receptors, and when thrown into the blood in the form of a vaccine it makes a better and more active vaccine, and more beneficial results are obtained by its use than are gained by that first grown from the individual; more particularly where the patient has been constantly poisoned for a long period of time.

I was misunderstood in regard to the purpose of my technique. The technique in obtaining material for cultures was, in the cases described, the all-important thing. I had not a thought about the benefit or harm to the patient. My principal thought was, if possible to recover from those abscessed cavities, in a moderately pure state, whatever might be in them, and I burned the sockets and used iodin for the purpose of eliminating extraneous infections, so the possible injury to the tissues was a matter of small moment to me in this connection.

The points made by Dr. Morris were excellent: "Keep your balance." The doctor was absolutely right, and I thank him for stating the fact that I do not believe everything is due to mouth infections. I am merely bringing to your notice the fact that

there are a certain proportion of infections of other parts of the body that are dependent on infections in the mouth.

There is no such thing as dental sepsis; there is sepsis. It may occur through the dental path, or it may occur through some other path. It is sepsis first, last, and all the time. If it occurs through the pulp canal, it is your business to shut that out; but do not let us make any such distinction as dental sepsis. Given a streptococcus viridans infection in the mouth, it is possible to produce varied and dangerous conditions because of their great ability to change their form and locality of attack. Let us get away from the idea that we have to call things by certain specific names that narrow their field of application, and let us appreciate how great is our responsibility in fields hitherto unrecognized.

Some one spoke about what the dental profession had done, and how much credit it should receive.

Gentlemen, a very remarkable character in the world's history, once said: " By their fruits ye shall know them." " Men do not gather grapes from thorns, nor figs from thistles," and if the septic dentistry shown on the screen here by one of the gentlemen to-night is germain, I think my quotation of Christ's saying forcefully controverts the gentleman's remarks. I thank you for your patience and attention

Adjournment.

FREDERICK C. KEMPLE, D.D.S.,
Editor, First District Dental Society.

FIRST DISTRICT DENTAL SOCIETY, STATE OF NEW YORK

March 2, 1914.

A regular meeting of the First District Dental Society of the State of New York was held at the Academy of Medicine, 17 West Forty-third Street, New York City, on Monday evening, March 2, 1914.

President Henry W. Gillett occupied the chair and called the meeting to order.

Owing to the severe snowstorm which had blocked railroad traffic, Dr. Edward C. Kirk, of Philadelphia, the essayist of the evening, was unable to be present; and his paper, entitled "The Reaction of the Saliva,"* was therefore read by Dr. B. C. Nash, of New York.

Discussion on Dr. Kirk's Paper.

Dr. William J. Gies—Mr. President, Ladies and Gentlemen: When I telephoned to President Gillett, at about one o'clock today, to inquire whether Dr. Kirk had been heard from, and was told that because of the storm he would doubtless not be able to leave Philadelphia but that his paper would be read in his absence, I realized that I should be at a great disadvantage in this discussion, which you have invited me to open. I had received, just a few minutes before that, a copy of Dr. Kirk's paper, which had been delayed in transmission. I concluded that since Dr. Kirk could not be present, it would be best for me to discuss his paper, so far as possible in terms of *recorded* knowledge, rather than in terms of any opinions of my own that I might offer. I have brought with me a large section of my library, as you see, for that purpose, having picked up as many old friends as possible during the afternoon.

Dr. Kirk is not here to reply to anything that I might offer as my own personal knowledge, but he has access in Philadelphia to the sources of printed information that are available here; and if I present what is thus accessible to him, I shall surely not be taking advantage of his absence.

* See Dr. Kirk's paper in full at p. 186 of the present issue of THE JOURNAL.

In the interest of definiteness and clarity as we proceed to consider Dr. Kirk's comment, and also for the sake of emphasis, let me read from his paper the general deductions with which he concluded his remarks:

"From the evidence at hand it would appear that (1) our views regarding the so-called alkalinity of the saliva need fundamental revision; (2) that observations upon the reaction of the saliva based upon the use of indicators of its reaction (a) are of very questionable value, and that (b) for precise work they are useless; and, finally, that (3) the part which mucin plays in the protection of tooth structure against corrosion by acids needs to be more fully studied before we can decide that the use of alkaline dentifrices is wrong, much less that the use of acid dentifrices is right."

For our convenience in this discussion let us consider the several groups of data and opinions on which each of these general conclusions appears to be based, rather than the details in the order of their presentation.

I. IS SALIVA AN ALKALINE LIQUID AND DO OUR VIEWS "REGARDING THE SO-CALLED ALKALINITY NEED FUNDAMENTAL REVISION?"

A. Let us be sure, to begin with, that we are going in the same direction. The appended quotations may serve as convenient guides (1-2).

"Clinical studies on acid-base equilibrium and the nature of acidosis": Palmer and Henderson, *Archives of Internal Medicine*, 1913, xii, p. 160.

1. "In physical chemistry acidity and alkalinity are expressed in terms of hydrogen- or hydroxyl-ion concentration. Pure water, H_2O, ionizes; that is, a few molecules break up into $\overset{+}{H}$ and $\overset{-}{OH}$ ions in equal numbers, and we have neutrality. The amount of ionized hydrogen in water is exceedingly small, about 1 gram in 10,000,000 liters at 25° C. The phrase "hydrogen-ion concentration" signifies the quantity of hydrogen ions present, expressed in terms of normality. Hence in water containing 1 gram of ionized hydrogen in 10,000,000 liters, or 0.000,000,1 gram in one liter, the hydrogen-ion concentration would be 0.000,000,1 N, which may be written 1/10,000,000 N, or expressed more conveniently algebraically,

1×10^{-7} *N*. We have then for the definition of neutrality, acidity and alkalinity:

$$(\overset{+}{H}) = 1 \times 10^{-7} = (\overset{-}{OH}), \text{ neutrality;}$$

$$(\overset{+}{H}) > 1 \times 10^{-7} > (\overset{-}{OH}), \text{ acidity;}$$

$$(\overset{+}{H}) < 1 \times 10^{-7} < (\overset{-}{OH}), \text{ alkalinity;}$$

$(\overset{+}{H})$ stands for hydrogen-ion concentration;

$(\overset{-}{OH})$ stands for hydroxyl-ion concentration.

"A clinical method for studying titratable alkalinity of the blood and its application to acidosis": Sellards, *Bulletin of the Johns Hopkins Hospital,* 1914, xxv, p. 101. (Delay in the publication of this discussion enables me to substitute this quotation from the April number of the *Bulletin* for equivalent remarks of my own after reading the foregoing quotation.)

2. "Inasmuch as the expression, 'the reaction of the blood,' has come to be used in two senses, a brief discussion of term is advisable. In its strict sense, the reaction of the blood depends upon the physico-chemical balance between the hydrogen and hydroxyl ions which it contains. *In this sense the blood is hardly more alkaline than distilled water.* More loosely, the reaction of the blood was formerly stated in terms of its behavior toward indicators and its ability to neutralize acids or bases. Although normal blood serum reacts as an acid toward a few indicators, notably phenolphthalein, yet it is definitely alkaline toward the majority of the common indicators and, since the alkaline reaction to these indicators can be maintained even after the addition of small amounts of acid, the blood is commonly spoken of as an alkaline fluid. From these considerations it will be seen that, although the physico-chemical measurements show the hydroxyl ion content of the blood to be very low, yet the blood contains a moderate quantity of substances which can readily yield hydroxyl ions upon the introduction of the hydrogen ion of an acid. *Thus it is seen that two distinct interpretations have arisen for the term, 'reaction of the blood.'* In the present paper this term will be used in its physico-chemical sense to indicate the balance between hydrogen and hydroxyl ions, and the behavior of the blood with indicators toward acids and bases will be designated as the titratable alkalinity. The question at once arises as to the relative importance in biological work of these two factors, namely, (1) the hydroxyl-ion content of the blood, and (2) its titratable alkalinity. It has been shown by Henderson[1] that the hydroxyl-ion content of the blood varies but slightly, even under extreme pathologic

[1] Henderson: *American Journal of Physiology,* 1908, xxi, p. 427. See also Palmer and Henderson: *Archives of Internal Medicine,* 1913, xii, p. 153.

conditions. *This relatively constant value of the hydroxyl-ion concentration is maintained, in part at least, at the expense of the titratable alkalinity.* . . . The *titratable* alkalinity is of *important biological significance,* while the available evidence indicates that the 'physico-chemical reaction' of the blood (H-ion concentration) is *maintained at a fairly constant value, even in outspoken grades of acidosis.*"

These quotations bring before us, for our guidance, the well known facts that "the reaction" of a solution is not *fully* indicated by the mere determination of its concentration of H or OH ions (*actual* acidity or alkalinity); it is necessary, besides, in order to comprehend "the reaction," to ascertain the *capacity of the solution to neutralize* alkali or acid when either is added to it (titratable or *potential* acidity or alkalinity).

That no revision of our views regarding the reaction of saliva is required by anything stated in Dr. Kirk's paper is shown by the following quotations (3-6).

B. Quotations from Mandel's translation (sixth German edition, 1906), of Hammarsten's *Text book of physiological chemistry* (repeated in the last edition, 1909): One of the most widely known and generally used of the text books in physiological chemistry.

Page 191: Relating to the *blood,* upon which the inorganic composition of the saliva is largely dependent directly.

3. "In the determination of the alkalinity of blood and blood-serum, up to the present time we have estimated the amount of alkali by titration with an acid. We cannot dispense with such determinations, although they do not yield any information as to the true alkalinity, apart from the fact that the results are dependent upon the indicator used, because we understand as true alkalinity the concentration of the hydroxyl ions. The Na_2CO_3 is in aqueous solution more or less dissociated into $2Na^+$ and $CO_3^=$, depending upon the dilution. The $CO_3^=$ ions combine partly with the H^+ ions of the dissociated water, forming HCO_3', and the corresponding HO' ions produce the alkaline recation. *If now, by the addition of a little acid, a few of the HO' ions are removed, then the equilibrium is disturbed, a new quantity of Na_2CO_3 is dissociated, and this process is repeated every time a new quantity of acid is added until all the carbonate is dissociated.* The dissociation of the carbonate existing in the original concentration, upon which the number of HO' ions is dependent, cannot therefore be determined by titration. For these reasons Höber has worked out a physico-chemical method of determining alkalinity, based upon Nernst's theory of liquid chains. This method was used later by Farkas, Fränckel, and Höber after a few changes. *The investigations of these last-mentioned experimenters show*

that the concentration of the hydroxyl ions in blood-serums and blood is nearly the same as in distilled water, and that these fluids are nearly neutral in behavior, which fact is caused by the presence of carbonic acid. Friedenthal,[3] by testing serum with phenolphthalein, arrived at similar results."

The foregoing quotation states facts that were current long before 1906. The well known difference between titratable (indicator, potential) alkalinity and electrometric (hydroxyl-ion, actual) alkalinity is emphasized and the importance of each is noted. The fact that titration "results are dependent upon the indicator used," and the reasons therefore, are stated here in a routine way. The influences which led to the development of the electrometric method are indicated.

Page 342: Relating to *saliva.*

4. "Its reaction (saliva) is generally alkaline to litmus. The degree of alkalinity varies considerably not only in different individuals, but also in the *same individual during different parts of the day,* so that it is difficult to state the average alkalinity. According to Chittenden and Ely, it corresponds to the alkalinity of 0.8 p. m. Na_2CO_3 solution, or to 0.2 p. m. solution, according to Cohn. According to Foa, the actual alkalinity (OH-ion concentration) is always considerably less than that found by titration, and *the reaction determined electrometrically is very nearly neutral.* The reaction may also be *acid,* as found by Stickler to be the case some time after a meal, but this is not true for all individuals."

That saliva was practically neutral in the electrometric sense was well known before Hammarsten wrote the remarks in this quotation. Dr. Kirk's paper presents nothing on this subject that requires revision of our knowledge regarding it.

C. Quotation from an abstract of a paper on "The reaction of some animal fluids": Chittenden, *Science,* 1897. v, p. 902.

5. "There is a general assumption on the part of physiologists that the alkaline reaction obtained with red litmus, in the case of many animal fluids, is due in great part to the presence of sodium carbonate. In many cases this assumption is quite erroneous. Thus, a large number of examinations of fresh bile from many species of animals shows that the fluid never contains any sodium carbonate; *although alkaline to red litmus, the fluid is invariably acid toward phenolphthalein,* 1 gram of bile requiring on an

[3] Höber, Pflüger's Arch., 81 and 99; Farkas, see Biochem. Centralbl., 1, 626; Fränckel, Pflüger's Arch., 96; Friedenthal, Zeitschr. f. allg. Physiol., 1 and 4.

average 0.4 milligram of NaOH to neutralize the free acid or acid salts present. With lacmoid, however, the reaction is invariably alkaline, thus *showing the absence of free acids. The salts Na_2HPO_4 and NaH_2PO_4 undoubtedly play an important part in determining the behavior of the bile toward different indicators.* As a rule, 5 c.c. of fresh ox bile require 0.5 c.c. of *n*/10 NaOH solution to render the fluid neutral to phenolphthalein and about 3.0 c.c. of *n*/10 HCl solution to make the fluid neutral to lacmoid.

"*Human mixed saliva is likewise acid to phenolphthalein;* on an average 5 c.c. of filtered saliva require 0.6 c.c. of *n*/10 NaOH solution to render the fluid neutral to phenolphthalein. Toward most other indicators the fluid reacts alkaline, viz., with rosolic acid, litmus, lacmoid, congo red, alizarin, etc."

Note the special reference to normal *acidity* of saliva, to the dissimilar results with the different indicators, and to the part played by phosphate in determining response to indicators. More detailed reference to these points was published by Chittenden and Richards in the following year (*American Journal of Physiology,* 1898, i, p. 461).

D. Quotation from the first annual report by Lothrop and Gies before this Society: *Journal of the Allied Dental Societies,* 1910, v, p. 274.

6. "In every instance we carefully determined the 'reaction' of the specimen of saliva to at least three indicators: phenolthalein, litmus and lacmoid. We gave considerable attention to this point because of the very good reason for believing that the production of acid by the action of micro-organisms is an important factor in the local disintegration of enamel. In practically every instance the reaction was *alkaline to both litmus and lacmoid.* In *every* case the reaction was *acid to phenolthalein.*

"The 'reaction' of the saliva has been the subject of considerable nonsensical comment. Many who write about this matter appear to be unaware of the fact that *a given solution may seem to be acid, neutral and alkaline at the same instant*—may, for example, be acid to *phenolthalein,* neutral to *litmus* and alkaline to *methyl orange.* Thus, specimens of urine are frequently found to be *strongly acid* to phenolthalein, *moderately acid* to litmus and *decidedly alkaline* to methyl orange. Urine is often *amphoteric* to litmus, *i. e.,* both acid and alkaline to that indicator. A solution is *neutral* when its concentrations of hydrogen and hydroxyl ions are absolutely equal. *No coloric 'indicator' shows that equality;* each of them indicates neutrality at a point where there is a *definite ratio other than equality* between the hydrogen and hydroxyl ions. This 'definite ratio'

varies with the quality and quantity of the indicator, and in harmony with the specific combining tendencies of the latter.

"*Phenolthalein* is one of the most satisfactory indicators. As ordinarily employed, *i. e.*, in alcoholic solution, it is colorless, but with a trace of alkali (hydroxyl ions) it yields a bright red color. On neutralizing this red solution with acid, or on adding to it an excess of acid, the solution is returned to the colorless condition *without any intermediate colorations*. Titrations can be made very sharply and decisively with phenolthalein. It is more sensitive than litmus. Unlike litmus, phenolthalein does not have three color phases; therefore, it does not induce the disconcerting doubts that occur at or near the neutral point in such a composite liquid as saliva when litmus is used. The disadvantages of other indicators need not be emphasized. It seemed more important for us to express the reaction of the saliva *in terms suggestive of the saliva's tendency to combine with additional basic material* (as determined with the aid of one of the most sensitive indicators, phenolthalein) than to express the reaction in terms indicative of the capacity of saliva to combine with more *acidic* substance (as determined with an indicator of less utility, such as litmus). This decision was obviously in the interest of the most significant and most accurate expression of reaction."

Dr. Kirk addresses you on this general subject without noting the fact that such data as those just quoted were formally considered by you here, several years ago. Dr. Kirk and his collaborators have ignored, however, not only these remarks, but also many other published statements and reviews of similar character.

Dr. Kirk appears to regard his observations as "absolutely proving the presence of phosphate in saliva." Practically every text book of physiological chemistry mentions the fact that saliva contains phosphate. The students in our laboratory courses in biochemistry have been ascertaining this fact for years, in accord with hundreds of publications to this effect. I made the observation myself in a series of routine tests in Professor Chittenden's laboratory twenty years ago—and it was ancient history then!

The "peculiarity of the salivary reaction" that is indicated by litmus, to which Dr. Kirk refers, viz., its amphotericity, is not at all peculiar. Solutions, such as blood, urine and saliva, which contain mixtures of mono- and di-hydrogen phosphates, as is well known, could hardly be expected to behave differently.

II. IS IT CORRECT TO CONCLUDE "THAT OBSERVATIONS UPON THE REACTION OF THE SALIVA BASED UPON THE USE OF INDICATORS OF ITS REACTION (A) ARE OF VERY QUESTIONABLE VALUE AND THAT (B) FOR PRECISE WORK THEY ARE USELESS"?

In his enthusiasm for the newer electrometric methods Dr. Kirk appears to have lost his perspective. He infers without discrimination.

E. *It has long been known that "indicators" are unlike, both qualitatively and quantitatively, in their indications.*

Note the import of the following quotation from a paper by Henderson in the *American Journal of Physiology* (1906, xv, p. 258):

7. "By the observations of Joly (*Comptes rendus hebdomadaires des seances de l'academie des sciences,* 1875, c, p. 55) the understanding of mixed solutions of Na_2HPO_4 and NaH_2PO_4 was materially advanced. He showed that, in the titration of phosphoric acid with sodium hydrate, helianthine and similar indicators serve to mark the formation of mono-sodium phosphate, and phenolphthalein the formation of di-sodium phosphate, whereas, as is well known, all these indicators mark almost precisely the same point in the titration of a strong acid with a strong base. Evidently, then, di-sodium phosphate is a very weak base."

These and similar facts regarding the dissimilarity, as well as differential serviceability, of indicators, have been well known for forty years.

I have brought, for your inspection, two books conveniently at hand which show that Dr. Kirk is suggesting nothing new in this connection.

In the volume by Glaser, on "*Indikatoren der Acidimetrie und Alkalimetrie*" (1901), which I present for your inspection, you will find the following classification of the indicators. *Group 1*: indicators which are sensitive to alkali, but very much less sensitive to acid; *group 2:* indicators which are more sensitive to acid, but much less sensitive to alkali, than those of group 1; *group 3:* indicators which are slightly sensitive to alkali but very sensitive to acid.

The book containing this classification, which emphasizes dissimilarity among the indicators, was issued thirteen years ago.

Here is another book, by Cohn, on "*Indicators and test-*

papers," issued in 1902. Examine this "tabular summary of principal indicators," which I have torn from its place in the back part of the book so that it may be unfolded and passed among you. Notice that, with the exception of thymolphthalein, the indicators referred to by Dr. Kirk are named at the top of the summary. Find phosphoric acid near the top of the first column, then read the remarks on that line under each of the names of the indicators at the tops of the columns. Observe the statements that litmus and phenolphthalein (and presumably thymolphthalein) are "*indistinct*" in their indications with phosphoric acid, that congo red is "*good,*" that methyl orange is "*very sharp; shows* $^2/_3$ X_2O *or* $^1/_3$ *acid.*" On page 56 of the same book it is stated that "*acid salts do not affect congo red*"; on page 57, "*bi-phosphates are neutral to congo red.*" Dr. Kirk has merely duplicated some of these observations, without adding anything significant.

By the use of suitable indicators and processes, the titratable-alkalinity or titratable-acidity of saliva, *i. e., the capacity of the saliva to neutralize (combine with) acid or alkali* may be determined satisfactorily for all ordinary biological purposes. Every method, including the electrometric for the determination of reaction, is deficient, of course, in its "*absolute*" indications.

The "factor of error" to which Dr. Kirk refers relates not so much to indicators individually as to *the judgment that determines the selection and use of a particular indicator for a given purpose.* In the light of our present knowledge of indicators the use of litmus, for example, for the titration of *phosphoric* acid, is about as accurate as the employment of a sieve for the measurement of water.

F. Not only may indicators be satisfactorily employed for precise determinations of "potential" (titrimetric) acidity and alkalinity, but the "actual" reaction, *i. e., the electrometric-acidity and electrometric-alkalinity of biological liquids, including saliva, may also be accurately determined with the aid of indicators, by colorimetric comparisons with solutions of tinctorial standards corresponding to known concentrations of H or OH ions.*

As a further indication of Dr. Kirk's loss of perspective in

this matter let me quote from several interesting papers, on the foregoing subject, of the many that record such data (8-11).

Quotation from a paper on "A clinical method for determining the alkalinity of the blood": Adler, *American Journal of Physiology,* 1907, xix, p. 1.

8. "The recent study of indicators by Salm (*Zeitschrift für physikalische Chemie,* 1906, lvii, p. 471), characterizing with the greatest accuracy a whole series of indicators, has suggested the possibility of devising a method at once certain, accurate and easy of application. . . . Two general methods of measuring quantitatively the reaction of a fluid may be pursued in any case: (1) Titration to an end point; (2) determination of the H and OH ionization (electrometric). The former method yields information concerning the *amount* of base and the *amount* of acid present in a solution, but (affords) no direct evidence concerning the nature of the *equilibrium.* According to such a method HCl and NaH_2PO_4 in equivalent amounts are equally acid. The latter (method) furnishes no direct information regarding the *absolute amounts* of base and acid in solution, but determines the intensity of alkalinity—the condition of *equilibrium* in the solution. . . . Salm has carefully studied the exact point of H and OH ionization at which a number of indicators turn, and accordingly *it has been possible to pick out from this list a certain number of these that give sharp color reactions at about the H-ion concentration of the blood—in particular two, rosolic acid and neutral red.*"

This is one of the many references in the literature which contradict Dr. Kirk's assertion that reaction cannot be precisely determined with indicators.

(In passing, let me say that I hope before long to report the results of studies of salivary reaction by a colorimetric procedure similar to those described in these quotations: 8-11.)

Quotation from a paper on a "Chart presentation on recent work on indicators": Walpole, *Biochemical Journal,* 1910, v, p. 207:

9. "During recent years the change of mental attitude of scientific workers toward indicators has been very pronounced. . . . In a recent paper Sörensen (*Comptes rendus des travaux du laboratoire de Carlsberg,* Copenhagen, 1909, viii, pp. 1 and 396) has published the results of an investigation of the H-ion concentration of various mixtures of pure substances and the corresponding color changes of an exhaustive list of indicators. . . . With reference to indicators, it may be stated that when an indicator assumes a certain tint intermediate between those of its strongly acid and alkaline solutions, it shows, within limits of accuracy

which experiments can determine, that *the solution in which it is dissolved has a certain definite H-ion concentration.* Further, when another solution is observed to have the same tint under identical conditions of temperature and dilution, *this second solution is found to have the same H-ion concentration as the first.* In brief, the *absolute* H-ion concentration can be measured in many ways, but most conveniently and directly by the potential set up between the solution and hydrogen; the *identity* of the H-ion concentrations of two solutions *can be established by the careful use of indicators.*"

Quotation from a paper "On the intensity of urinary acidity in normal and pathological conditions": Henderson and Palmer, *Journal of Biological Chemistry,* 1913, xiii, p. 393. (See also the same authors, *Archives of Internal Medicine,* 1913, xii, p. 153.)

10. "Accordingly precise and numerous data of urinary acidity, both normally and pathologically, appear to be desirable. Fortunately the researches of Sörensen make this task an easy one. His researches have made possible the convenient use of a considerable variety of indicators and provided ingenious and convenient refinements which enhance their accuracy. Our investigations, recorded in this paper, *yield a confirmation, if such be necessary, of the reliability of these methods.*

"We have as before estimated the urinary reaction after the addition of indicators by matching colors of uriniry samples with those of standard solutions of known reaction. . . .

"In recording H-ion concentration (determined in this way), etc. . . . These results *not only justify the use of any one of several indicators, but also give added assurance of the reliability of the measurements.* Even more important, however, is the fact that the observations are at any time subject to further experimental investigations, *because the standard solutions can at any time be reproduced. It is also to be noted that for all practical purposes the reference of urinary reaction to such a series of solutions is quite as satisfactory as reference to the actual H-ion concentration.*

"Having in this manner confirmed the earlier work and *found that the possible choice of indicators is a large one,* etc."

Quotation from a paper on "The concentration of hydrogen ion in sulfuric acid": Tolman and Greathouse, *Journal of the American Chemical Society,* 1912, xxxiv, p. 364.

11. "Sulfuric acid may dissociate according to either or both of the reactions:

$$H_2SO_4 \rightleftharpoons H^+ + HSO_4^-$$
$$H_2SO_4 \rightleftharpoons 2H^+ + SO_4^=$$

Since its method of dissociation is unknown, *it is impossible to calculate, from conductivity measurements alone, either the degree of dissociation of*

the acid or the concentration of any of the ionic substances produced.

"It occurred to the authors that the concentration of hydrogen ion in sulfuric acid *could be most easily determined by the use of an indicator.* The method consists in finding a solution of hydrochloric acid which imparts the same color to a definite concentration of indicator as the sulfuric acid under consideration.[3]

"We may consider an indicator as a weak acid which ionizes according to the reaction

$$HIn = H^{+} + In^{-},$$

the undissociated acid and its ion differing in color.

"The hydrogen-ion concentration of the solution in which the indicator is present will determine the degree of ionization of the indicator, and hence indirectly its color. If we find a solution of hydrochloric acid which gives the same color with the same amount of indicator as the solution of sulfuric acid under consideration, *the two presumably have the same concentration of hydrogen ions, which can be calculated for the hydrochloric acid from conductivity data.* . . .

"From an examination of the last lines in Tables I-III, it will be seen that the different acids and *the different indicators lead to approximately the same values for hydrogen-ion concentration in sulfuric acid.* Small differences between the values obtained by using different indicators and different comparison-acids are to be expected from the probability of slight but unknown action between indicator and the acid radical. Nevertheless, assuming that conductivity measurements for uni-univalent acids give a true measure of degree of dissociation,[4] we may conclude that the values we have presented for the hydrogen-ion concentration in sulfuric acid are approximately correct."

Besides copies of the original papers from which these *illustrative* quotations (8-11) were taken, let me also present for your inspection a copy of part 2 of "*Der Harn sowie die übrigen Ausscheidungen und Körperflussigkeiten,*" by Neuberg (Berlin, 1911). The exhaustive treatment of "Indicatorenmethode," for the determination of the reaction of biological liquids (pp. 1566-80), will increase your surprise that Dr. Kirk could have overlooked so much that is well known to every active worker in biological chemistry. The opening sentence under the heading "Indicatorenmethode" runs as follows: "Die Indicatorenmethode, die sich in den letzten 5 Jahren entwickelt hat, ist von

[3] Indicators were first systematically used for determining hydrogen-ion concentration by Friedenthal, *Z. Elektrochem.*, 10, 119 (1904). See also Salm, *Z. physik. Chem.*, 57, 471 (1907).

[4] For a consideration of the possibility that conductivity measurements do not give true values for the degree of dissociation, see Tolman and Ferguson: *Journal of the American Chemical Society*, 34, 232 (1912).

sehr grosser Bedeutung, *da sie ohne komplizirte Apparate und mit verhältnismässig einfacher Technik eine genaue Messung der Reaktionen gestattet* und folglich sehr bald *eines der wichtigsten Hilfsmittel für die Physiologie und die Klinik zu werden verspricht.*"

Examine also Sörensen's splendid review in this copy of the *Ergebnisse der Physiologie* (1912, pp. 423-449), and Friedenthal's in this copy of Abderhalden's *Handbuch der biochemischen Arbeitsmethoden* (1910, i, p. 534 and 560), for further evidence of the well known fact that indicators may be used with ease, precision and satisfaction for the determination of the reaction of biological liquids, from both the titrimetric and electrometric standpoints. They *are* so employed to-day in the leading chemical laboratories everywhere.[5]

III. DR. KIRK'S IDEAS ON THE PART WHICH MUCIN PLAYS IN THE PROTECTION OF TEETH AGAINST DESTRUCTIVE ACTION BY ACIDS

G. After discussing salivary alkalinity in terms of phosphate and mucin, as factors affecting it, and also with reference to titrimetric and electrometric processes, as methods of determining it, Dr. Kirk concludes as follows:

12. "It is theoretically possible[6] that some portion of the solid inorganic constituents of the saliva may have basic qualities, and would be, therefore, capable of in a degree neutralizing acid ions, but as the solid inorganic constituents normally vary from 0.4 to 0.6, the neutralizing power of the inorganic solids, even assuming that they were all basic, would not materially increase[7] the total neutralizing power of the saliva for acids. . . . In view, then, of the extremely low alkalinity of the normal saliva considered in a quantitative sense as measured by the basic ions in average normal saliva,[8] it becomes pertinent as well as interesting to inquire into the accuracy of the frequently reported high alkaline index of the saliva. It is especially important that the neutralizing power which the basic ions of the saliva represent,[9] should be known with some fair

[5] See a paper by Henderson, issued since the foregoing was stated, in the *Journal of Biological Chemistry*, 1914, xvii, p. 305 (April); also Sellards, *Bulletin of the Johns Hopkins Hospital*, 1914, xxv, p. 101 (April).

[6] It is a well-known *fact*.

[7] Dr. Kirk evidently uses "increase" to signify *affect*.

[8] Dr. Kirk refers to the *actual* reaction, which is not an expression of *the* "neutralizing power."

[9] It is not clear whether Dr. Kirk means *actual* or *potential* reaction here. See footnote 8.

degree of accuracy in order that we may determine to what degree or extent the actual (!) alkalinity[10] of the saliva can exert a protective effect against the destructive action of acids upon the hard dental structures. . . . It is evident from comparing the above results (Table C) that saliva exerts a far greater neutralizing power than is indicated by its alkalinity,[11] which can be explained by the fact that the mucin is capable of removing the acid from the solution by precipitation,[12] this being borne out by the appearance of a white cloud in the solution on the addition of the second c.c. of saliva.[13] . . . It seems evident that the power which the saliva possesses to rid itself[14] of acids and incidentally to exert a protective function against acid destruction of tooth structure, is not in any large degree, if at all, dependent upon chemical neutralization of the acid by the contained basic ions of the saliva,[15] but is rather dependent almost wholly upon the precipitation by the salivary mucin as an acid-mucin coagulum.[16] . . . It would be interesting to know in this connection just what alkaline salts exist in the saliva that are capable of neutralizing any acid.[17] The alkalinity of the saliva, so far as I am aware, is dependent upon the presence of phosphates which are alkaline to indicators, but I am unable to write any equation, and I have found no chemist who could do so, that will represent the neutralization of a free acid by a phosphate without such reaction coming out with an acid at the end.[18] *If* the so-called alkalinity[19] of the saliva should eventually be found to mean merely the physical clearing of the saliva of its acid by means of a mucin coagulum,[20] our problem with reference to the relative value of acid or alkaline dentifrices takes on a new and interesting aspect."[21]

This is a very important paper for several reasons. Dr. Kirk is one of the most prominent representatives of dentistry in this country. He is the editor of one of the leading dental journals. A great stream of important literature passes continu-

[10] This suggests an answer to the doubt expressed in footnote 9—but the *actual* alkalinity of the saliva is so slight that the saliva is practically neutral; the *actual* alkalinity is therefore too trifling to exert an appreciable "protective effect against the destructive action of acids upon the hard dental structures." The alkalinity that *protects* is the *potential* (titratable) alkalinity, not merely the *actual* (electrometric) alkalinity *at a given moment.*

[11] Does Dr. Kirk mean *actual* or *potential* alkalinity in *this* case?

[12] An inference unwarranted by anything we *know.*

[13] Dr. Kirk forgets that an *excess* of precipitative acid is required to effect agglutination.

[14] What acids does it contain from which it "rids itself"?

[15] This implies that Dr. Kirk is thinking of *actual* alkalinity here, and has again forgotten about *potential alkalinity.*

[16] None of this has ever been verified by experiment.

[17] The contained phosphates and bi-carbonates do so.

[18] See such an equation on page 289. Note the comment on page 289 regarding the incorporation by Dr. Kirk of this illustration into his own paper, without acknowledgment.

[19] Which alkalinity: *actual* or *potential?*

[20] "*Physical* clearing" means mechanical removal—a fantastic conception, in the light of what is known *chemically* of the situation.

[21] The "if" with which the sentence begins looks immobile to me.

ously through Dr. Kirk's editorial brain. It is necessary, therefore, for you to regard, and for me to accept, this paper as the best possible expression, by the dental profession, on the very elementary biochemical matter to which it refers. Because the paper comes from a source at once so dignified and authoritative, it is incumbent upon me to treat it with all due consideration; but the foregoing quotation from Dr. Kirk's paper presents such a burlesque on biochemistry that it taxes all my ingenuity and self-control to discuss it decorously. I fear that Dr. Kirk has permitted a very young and inexperienced assistant to write, without critical revision, practically all of this last quotation from his paper.

Condensed to a few words the last quotation from Dr. Kirk's paper states, in the main, that the inorganic solids (including phosphates and bi-carbonates, of course) of the saliva "do not materially increase (*i. e.*, account for or affect) the total neutralizing power of the saliva for acids," but the neutralizing power is "dependent almost wholly upon the precipitation by the salivary mucin as an acid-mucin coagulum." The misstatements of fact, and the fallacious inferences, in the foregoing general summary of Dr. Kirk's chief argument (some of which I have also indicated briefly with footnotes on the manuscript of this discussion), may readily be seen from the appended quotations from, and brief statements about, established chemical knowledge (13-18).

H. *The salts of phosphoric and carbonic acids, in saliva, and also in protoplasm, blood, urine, etc., can and do neutralize (combine with) relatively large proportions of acid or alkali ("titratable" alkalinity, "potential" alkalinity) in such a way as to prevent material change in the concentration of H ions, i. e., without significant alteration of the actual (electrometric) reaction.*

Quotations from some of the classical papers by Henderson (since 1906), supporting the foregoing proposition, are appended (13-18).

"Equilibrium in solutions of phosphates": Henderson, *American Journal of Physiology*, 1906, xv, p. 268.

13. "Evidently in solutions of mixed mono- and di-sodium phosphates the hydrogen and hydroxyl ionization is always very small, as was to have

been expected according to the theoretical discussion. Thus the organism and all living cells possess, *in the abundant quantities of phosphates which they hold in solution,* an efficient mechanism to prevent the occurrence of considerable hydrogen or hydroxyl ionization, that is to say, of even slight acidity or alkalinity. For it is evident that *to a mixed phosphate solution enough strong alkali or acid to produce either exclusively mono- or di-sodium phosphate may be added without causing more than faint acidity or alkalinity.*

If, for instance, hydrochloric acid be added to a solution of sodium phosphate, the reaction $Na_2HPO_4 + HCl = NaCl + NaH_2PO_4$ takes place, and so long as the amount of HCl added is less than enough to convert all the di-sodium phosphate into mono-sodium phosphate *the hydrogen ionization will correspond closely to that of the resulting mixture of the two phosphates,* and free hydrochloric acid will be absent from the solution, save for an *infinitesimal* amount.

"The peculiar importance of phosphates in this respect rests, then, not upon a unique property of their solutions, but upon the facts that in all living protoplasm they are the chief saline constituents and that they are capable of exceptionally great variation in the ratio of base to acid, with exceptionally little resulting variation in hydrogen ionization, as above explained. *How they share in this regulatory mechanism with the bicarbonates is clear from a consideration of the nature of the reaction,*

$$Na_2HPO_4 + H_2CO_3 \rightleftharpoons NaH_2PO_4 + NaHCO_3.$$

When, on the addition of acid to a solution of sodium phosphates and carbonates, the acidity of the phosphates has reached a certain point, the amount of bicarbonate present being probably little affected up to this point, the continued addition of acid must decompose the sodium bicarbonate. When the sodium bicarbonate is completely decomposed, the ratio between mono- and di-sodium phosphates, during the period of decomposition of sodium bicarbonate probably but slightly affected, again begins to change rapidly, and eventually the solution will contain only acid sodium phosphate and the sodium salts of the acid added.

"*The hydrogen ionization of blood serum corresponds to that of solutions of mixtures of $Na_2HPO_4 + NaH_2PO_4$, in which the ratio of the two constituents varies between 6 : 4 and 1 : 0 approximately.* Variation within this range being presumably harmless, protoplasm possesses in the phosphates, aided by other substances in less degree, *a mechanism whereby great quanities of acid or alkali may be immediately neutralized and the hydrogen ionization preserved within normal limits.*"

"Concerning the excretion of phosphoric acid during experimental acidosis in rabbits": Fitz, Alsberg and Henderson. *American Journal of Physiology,* 1907, xviii, p. 113.

14. "In protoplasm phosphates are present in very great amount, undoubtedly as mixtures of mono- and di-potassium phosphates and similar salts; *such mixtures constitute a nearly neutral solution which has the remarkable property of being able to take up large quantities of acid or*

alkali without becoming acid or alkaline. This behavior is easily explained by the facts that acid sufficient to convert all the di-potassium phosphate of such a mixture into mono-potassium phosphate must be added *before the slight acidity of the pure mono-potassium phosphate is obtained,* and that enough alkali to convert all the acid-potassium phosphate into di-potassium phosphate must be added *before the faint alkaline reaction of the latter substance is obtained,* while, in accordance with the requirements of the concentration law, *all mixtures of the two substances are much more nearly neutral than either alone.* Accordingly, if acid is introduced into protoplasm in a form more strongly acid than acid potassium phosphate, it must immediately react with di-potassium phosphate and similar substances forming a salt and acid potassium phosphate according to the reaction,

$$K_2HPO_4 + HX = KH_2PO_4 + KX.$$

Other substances, of course, such as carbonates and proteins, are not without concern in the readjustment of equilibrium, but on the whole there is good reason to attach to them a *minor importance,* at least in the first stages of acid intoxication when little acid has been neutralized."

"A study of the equilibrium between carbonic acid, sodium bicarbonate, mono-sodium phosphate and di-sodium phosphate at body temperature": Henderson and Black, *American Journal of Physiology,* 1908, xxi, p. 426.

15. "Experimental data are reported concerning the constitution, at body temperature, of aqueous solutions in which are present carbonic acid, sodium bicarbonate, mono-sodium phosphate, and di-sodium phosphate.

"It is shown that in such solutions the equilibrium may be defined by the proportion:

$$\frac{NaH_2PO_4}{Na_2HPO_4} : \frac{H_2CO_3}{NaHCO_3} = 3.3 : 1.0.$$

This relationship corresponds to the requirements of the concentration law.

"It is pointed out that these facts serve to define very accurately *the most important equilibria of neutrality regulation in the aqueous solutions of the body.*"

"The theory of neutrality regulation in the animal organism": Henderson, *American Journal of Physiology,* 1908, xxi, p. 447.

16. "These various conclusions, taken together, indicate that the physiological mechanism for the preservation of neutrality, or more precisely of a condition in which approximately $(\overset{+}{H}) = 0.4 \times 10^{-7}N$ and $(\overset{-}{OH}) = 7.2 \times 10^{-7}N$ at 38° C. in the aqueous solutions of the body, possesses a remarkable and unsuspected degree of efficiency. *The regula-*

tion in true aqueous solution is due mainly to carbonates and phosphates, though other substances, as for instance the proteins, play a minor part. The efficiency is dependent upon the avidity of carbonic acid and monosodium phosphate as acids and on their high diffusibility, on heterogeneous equilibria selectively adjusted, and on the mechanism for the excretion of carbonic acid and for the regulation of osmotic pressure. *The adjustment is of such a nature that large accidental variations in the concentrations of any of the constituents of the reaction, such as may normally occur, can hardly produce an appreciable effect upon the hydrogen-* and *hydroxyl-ion concentrations.* That is to say, that the process possesses a high factor of safety,[22] thereby conforming to the requirements of an efficient biological process."

"On the neutrality equilibrium in blood and protoplasm": Henderson, *Journal of Biological Chemistry,* 1909, vii, p. 29.

17. "The above estimate of the neutralizing power of proteins corresponds well on the whole with the known strength of amino-acids, and it would be difficult indeed, in view of the known avidity of amino-acids, both in their basic and their acid characteristics, to account for a larger neutralizing power of proteins in true solution, unless the proteins were made up exclusively of the more strongly acid protein derivatives like aspartic and glutamic acids, or of some other acid substances, as in the case of casein. In basing some of his conclusions (pp. 313, 315, 316, 317, 318) upon the behavior of casein, Robertson is, in fact, assuming a burden of proof, for, wthout evidence to the contrary, our chemical information would be taken as sufficient indication that casein is a far more acid substance than are the proteins of blood serum. *But even casein, according to Robertson's data, seems to be far less efficient than the bicarbonate of blood to preserve neutrality through the range of reaction which we are here considering.*

"*I conclude, then, that in neutralizing acid, sodium-protein compounds of blood plasma in true solution are certainly not more than one-fifth as efficient as bicarbonates,* unless existing data are seriously at fault. This conclusion rests upon the concentration law and upon no other foundation save experimental data."

"A critical study of the process of acid excretion": Henderson, *Journal of Biological Chemistry,* 1911, ix, p. 403.

18. "Throughout the animal body, while life exists, there occurs a regular formation of acid substances, excretory products of metabolism. As they form, these various matters, carbonic acid, sulphuric acid, and phosphoric acid in the main, immediately combine, but only partially, according to their several avidities, with the basic constituents of protoplasm and blood. In pathological conditions great quantities of acetoacetic acid and β-oxybutyric acid may be produced and claim their share of base. Thus, through resulting changes in equilibria between bases and acids, normal

[22] Meltzer: *Journal of the American Medical Association,* 1907, xlviii, p. 655.

metabolism steadily operates to lower the unvarying alkaline reaction[23] of the body. This tendency is held sharply in check by special protective mechanisms, acting co-ordinately, in co-operation and regular succession.

"The chemical reactions whereby such material is first neutralized, the chemical substances which aid in neutralization, the shares of more important substances in the process, and their efficiency, the changes in chemical equilibria, including resulting changes in hydrogen and hydroxyl-ion concentrations, all, so far as they concern true solution, *are known with a fair approach to certainty. Principally this work of neutralization is done by salts of phosphoric and carbonic acids, with aid from the amphoteric proteins.*[24] In simplified form the process may be represented by the two reactions, $M_2HPO_4 + HA = MA + MH_2PO_4$; $MHCO_3 + HA = MA + H_2CO_3$, where M stands for any basic radical, A for any acid radical. Other less important simultaneous reactions are of the same type, except, perhaps, the union of the weak acids with basic proteins like globine, and the union of bases with more acid proteins. *Through the remarkable circumstances that phosphates and carbonates possess, among all known chemical substances, the highest power to preserve neutrality in solution, this function is so well performed that the alkaline reaction of the body scarcely varies, even when the load upon the mechanism is heavy.*"

[A complete review of current knowledge of the regulating action of phosphates and bi-carbonates on the actual reaction in the cells, tissues and body fluids was published by Henderson in the *Ergebnisse der Physiologie,* 1909, viii, p. 254. See also Palmer and Henderson, *Archives of Internal Medicine,* 1913, xii, p. 153.]

I. The facts in the foregoing quotations, which are now the current views on the subjects referred to, completely refute the main argument, in Dr. Kirk's paper, that was quoted at the head of this section (III). What is true of protoplasm and blood, for example, with their large contents of protein and small proportions of salts, is *relatively more pertinent to saliva,* in which the salts amount to the comparatively large proportion of approximately 50 per cent of the total quantity of matter in solution.

[23] Or *neutrality. The terms may be used interchangeably for an alkalinity which is so slight.* The reaction at 18° is actually that of a sodium hydrate solution of strength 0.0000003 *n*, containing 0.000012 gm. NaOH per liter.

[24] Henderson: On the neutrality equilibrium in blood and protoplasm, *Journal of Biological Chemistry,* vii, 29, 1909, and Robertson: *Ibid.,* vii, 351, 1910. These two papers clearly show that the serum proteins are of considerable *secondary* importance in the process, through variation in the amount of alkali which they bind. Probably the major part of the protein content of the body is similar to these substances in power to combine with alkali in solution. What may be the case with undissolved proteins, through heterogeneous equilibrium and adsorption phenomena, we cannot say. In this connection one naturally thinks of the *acid nucleoproteins.*

The observations recorded in these quotations also give a clear explanation of the facts referred to, at the beginning of Dr. Kirk's paper, in the following language: "Or otherwise stated (its amphotericity indicated that), the saliva contained two substances of acid and basic properties respectively not capable of neutralizing each other, which confronts us with the deduction that the basicity or alkalinity of the saliva, to some degree at least, is dependent upon the presence of a substance or combination which *renders it incapable of neutralizing the source of acidity with which it is associated!*"

The observations in the foregoing quotations also enable us easily to appraise the value of the following statement in Dr. Kirk's paper: "That the protective power of the saliva against acid action on tooth structure is due to the neutralization of acids by the alkalinity or basicity of the saliva is extremely problematical!"

The data in the foregoing quotations show definitely that such high degrees of potential alkalinity as those reported for saliva by many observers, among them by Pickerill, to whose method and data Dr. Kirk particularly objects, are entirely in accord with the facts of salivary composition. The same data give a convincing explanation of the fact to which Dr. Kirk alludes when he says that "saliva exerts a far greater neutralizing power (*potential* alkalinity) than is indicated by its alkalinity" (*i. e.*, by its OH content or *actual* alkalinity).

The titratable alkalinity (*potential* alkalinity) is obviously much more important from dental standpoints than the electrometric alkalinity (*actual* alkalinity). Normal saliva is practically neutral, so far as *actual* reaction is concerned. Such saliva presumably fails to attack the teeth, but any neutral saliva with an *acid* POTENTIAL, *i. e.*, one able to neutralize a material proportion of alkali, or to react with basic matter such as calcium phosphate, would tend to decalcify teeth and thus erode them.

The data in the foregoing quotations indicate clearly, also, that Dr. Kirk's confidence in the neutralizing power of mucin is misplaced. Dr. Kirk ascribes to mucin certain qualities that it cannot be said to possess. He has overlooked the fact that mucins and mucoids do not show material combining power with acid—these glycoproteins are practically "saturated" by

their own acid radicals. The first allusion to this fact was published during my earliest years as an investigator of the glycoproteins.[25] That mucin, which is practically insoluble in water, combines with bases to form water-soluble dissociable compounds, "mucinates," is well known to you from the facts Dr. Lothrop and I reported and demonstrated here a year ago last October.

Mucin ordinarily occurs in saliva as soluble mucinate not as mucin. When we speak of the "mucin in saliva" we are no more accurate literally than when we say the "sun is rising." These are terms of convenience: in the use of the former we *mean* (or *should* mean) the protein-acid *radical* contained in the compound, mucinate; by the latter we imply (or should imply) a rotation of the earth that causes the sun to *appear* to rise. Any power exercised by salivary "mucin" as Dr. Kirk uses the term (*i. e.*, by salts of the protein-acid, mucin), to neutralize acid, is due to the *basic* part of the mucinate; but the basic portion of salivary mucinate is much less in quantity than the proportionate yield of ash, which is only about 3 per cent. The amount of acid required to precipitate mucin from a neutral solution of its sodium salt (a typical mucinate) is little, if any more, than the quantity required to unite with all of the basic element in the mucinate. That mucin does not combine molecularly with acid to an appreciable degree, when acid precipitates it, is shown by the fact that, in the conventional methods for the purification of acid-precipitated mucin, all traces of the anion of the acid employed for the purpose may be easily flushed out of the precipitated product—and without any evidence of hydrolysis. Mucin is not "coagulated" by acid when the latter precipitates it, nor has any one ever presented any evidence to show the occurrence of any coagulation of mucin under any circumstances. A precipitate may have none of the qualities peculiar to a coagulum.

I would revise Dr. Kirk's chief remark on this general point with the changes indicated by italics as follows: "It *is* evident that the power which the saliva possesses to *neutralize* acids and incidentally to exert a protective function against acid destruction of tooth structure is *almost wholly* dependent upon chem-

[25] Gies: Proceedings of the American Physiological Society, *American Journal of Physiology*, 1903, viii; Proceedings, p. xiii; also Gies and collaborators: *Biochemical Researches*, 1903, i, p. 54.

ical *reaction with* the acid by the contained basic ions (*actual and potential*) of the saliva *and is* dependent, *to only a comparatively small degree,* upon the precipitation *of* mucin *from the contained mucinate.*" This is equivalent to saying that Dr. Kirk's "No" should have been "Yes."

Equations "that will represent the neutralization of a free acid by a phosphate without such reaction coming out with an acid at the end," and which Dr. Kirk says he is "unable to write" or to find any "chemist who could," are abundantly suggested in the foregoing quotations from Henderson's papers (13-18). Let me write another on the blackboard, as follows:

$$Na_3PO_4 + HCl = Na_2HPO_4 + NaCl$$

The products of this reaction between normal sodium phosphate and hydrochloric acid are a *basic* compound and a *neutral* salt.

[*After* the return, to the editor, of the corrected galley proofs of my part of this discussion, he courteously placed in my hands a copy of the galley proof of Dr. Kirk's paper and reply to my remarks. I have asked for the privilege of adding these sentences in parenthesis here and the brief comment at the end (page 309).

I find that Dr. Kirk has incorporated into his formal paper the illustrative equation above—the one I wrote on the blackboard to present the kind of information he said in his original paper he neither had nor could obtain. I could have no objection to Dr. Kirk's use of my illustration or to the change in the point of view its use implies, for I believe an author should be privileged to strengthen the expression of his views, both by addition and subtraction, up to the last minute before formal publication. It would have been less confusing to the *readers* of this discussion, however, and historically correct, if Dr. Kirk had accepted the equation for use solely in his discussion rather than for adoption into the paper where it did not appear and where its absence led to its presentation by me in the first place. Dr. Kirk's embarrassment in this matter would have been removed if he had frankly admitted, in his discussion, that he overlooked the very elementary chemical fact which the equation illustrates. His seeming inability to comprehend the essential chemical facts in the case is not disguised, however, by his free use of the equation suggested by me in the discussion of this point. He says: "Although Na_2HPO_4 is in itself alkaline in reaction, does not change the chemical fact that it is as much an acid as HCl, differing from it only in strength!" Dr. Kirk might as well contend that water resulting from the reaction between sodium hydroxide and hydrochloric acid ($NaOH + HCl = HOH + NaCl$) is "as much an acid as HCl, differing from it only in strength" and that, on that account, NaOH does not neutralize HCl, or vice versa. Dr. Kirk goes to the extreme of designating, as an acid, a

substance which is *one of the most important bases in protoplasm*—an acid that "differs in acidity from HCl only in strength," but which has an "alkaline reaction"! But beyond all this Dr. Kirk forgets the most important point of all—it was his expression of doubt that phosphates are able to neutralize acidity that led to his challenge to us to show that they can do so. Now he is not only in the predicament of insisting that a well-known base with an "alkaline reaction" (Na_2HPO_4) is "an acid," but also is under the necessity of deciding whether he prefers to abandon his original contention, regarding the incapacity of phosphate to neutralize free acid, or to adhere to the latter and repudiate his inferences from the adopted illustrative equation, for the more he insists that Na_2HPO_4 is "an acid like HCl, *differing from the latter only in strength*," the more it follows he must agree that HCl is neutralized when it is treated with Na_3PO_4, and that, by the ensuing reaction, it is replaced by the infinitely weaker "acid," Na_2HPO_4—an acid with an "alkaline reaction"! I fail to see that the selection of either alternative can offer any comfort to Dr. Kirk at this stage of this discussion.

In his reply to my remarks (p. 306), Dr. Kirk says he would like to ask "what explanation" I have to "make of the potentiality of the hydrogen ion in the hydrogen di-sodium phosphate resulting from the reaction." My answer is that its "potentiality," like that of the potentiality of hydrogen in water, does not affect the facts that hydrogen di-sodium phosphate is a weak base and that water is a neutral substance; neither does this "potentiality" hide the fact that the reaction does not "come out acid at the end," as Dr. Kirk tries to persuade himself to believe. Dr. Kirk's reception of my correction of his palpable blunder in this connection, as shown by his comment in reply to my criticism, does no credit whatever to his standing as an investigator.]

It must be evident from the foregoing facts that there is nothing, old or new, in Dr. Kirk's paper that warrants any inferences for or against the use of any dentifrice. His comment in this connection is irrelevant. It is obvious, also, that mere speculation on this subject, before *this society*, at a time when alkaline dentifrices are notoriously failing to prevent caries and when investigation regarding other dentifrices is in progress under *your* auspices, would be both pointless and fruitless. You may *believe* that alkaline dentifrices are *the* thing, but you cannot base any such conviction on anything brought forward by Dr. Kirk in this paper to-night.

IV. GENERAL DISCUSSION.

J. I have touched, I believe, on all the *main* points in Dr. Kirk's paper, but I am loth to discontinue because many mat-

ters of detail require attention. I desire to perform this duty thoroughly. Permit me, then, to discuss some of these details before I conclude.

Dr. Kirk refers to sodium phosphate and calcium phosphate as the "principal and characteristic basic salts of the saliva," with "a marked predominance of the former over the latter." I am under the impression, which is correct, I think, that *potassium* phosphate is the predominant salin in the saliva.

It is incorrect to assume, with regard to saliva, that "its acidity is ordinarily a secondary or acquired condition which is not characteristic of the secretion." Ordinarily saliva is *actually neutral,* although it is *potentially* alkaline to some indicators (*e. g.,* methyl orange) and potentially acid to others (*e. g.,* phenolthalein).

Dr. Kirk states that di-hydrogen sodium phosphate "exhibits an acid reaction to indicators." This is only a part of the story and no more expressive of all the essential facts than the equally truthful assertion that di-hydrogen sodium phosphate is *neutral* to indicators. Examine again the table from Cohn's book on indicators. Di-hydrogen sodium phosphate, in the proportions in which it occurs in saliva, is apparently devoid of any destructive effect on teeth and fails to precipitate mucin from saliva or from a neutral solution of salivary mucinate. This statement does not apply to preparations of di-hydrogen sodium phosphate *containing phosphoric acid.*

About the middle of his paper Dr. Kirk quotes Pavlov to the effect that "acids and alkalies, in marked distinction to all other chemical reagents receive (induce a flow of) a saliva very rich in *protein* material. Their harmful effects on the buccal mucous membranes are thereby greatly reduced. That these measures are of use is shown by the fact that large quantities of 0.5 per cent. hydrochloric acid can be repeatedly poured into a dog's mouth without causing the least injury." (*One wonders how closely the teeth were examined in this connection!*) Near the end of his paper, recurring to this quotation from Pavlov's book, Dr. Kirk says: "Pavlov, as already quoted at the beginning of this paper, states that both acids and alkalies stimulate a flow of saliva 'very rich in protein material,' *i. e., a mucinous saliva.*"

I object to Dr. Kirk's insertion of the phrase "*i.e., a mucinous saliva*" as a synonym for Pavlov's term "protein," in spite of the fact that his modified quotation might be directed more appropriately against alkaline dentifrices than against acid ones. I must object to the practical substitution of *mucin* for "protein" in Pavlov's comment, because Pavlov did not use "mucin" or mean to use it as a substitute, because he knew too well not to use it in that way, and *because he stated elsewhere specifically the contrary*.

Although I do not have, and could not obtain this afternoon, a copy of the *American* edition to which Dr. Kirk refers, I brought with me my own copies of the German and English editions of Pavlov's book. Examine the copy of the English edition at page 151 and read the part I have marked there, which runs as follows:

19. "Upon all substances which the dog rejects—for example, acids, salts, bitter and caustic substances—saliva will likewise be poured, because these require to be neutralized, diluted or washed out of the buccal cavity. This explanation is fully confirmed by the absolutely constant and striking fact that *a thin watery saliva, containing mere traces of mucin, is poured out by the mucous salivary glands upon every substance, without exception, which requires to be removed,* while upon eatable substances a slimy mucin-holding fluid is secreted which lubricates the food bolus and facilitates its descent through the oesophagus. Further, the quantity of saliva secreted is closely related to the dryness of the food. The drier this is, the more saliva flows—a striking proof that the first of the digestive glands adapts itself to the physical conditions of the food. *Of special interest is the peculiar relationship between the parotid secretion and acids.* For these, a saliva is always secreted which is particularly *rich in proteins*. This peculiarity is still without an explanation. Perhaps it concerns some antitoxic precautionary measure."

You see that there is no justification whatever for Dr. Kirk's assumption that Pavlov meant "mucin" when he said *protein*. Observe Pavlov's careful use of the two terms in the above quotation. You detect also the fallacies in Dr. Kirk's assumption that, in the use of an acid dentifrice, there is danger (to the teeth) that an ensuing *abundance* (!) of mucin will yield an "acid-mucin coagulum, which if not removed by brushing or by neutralization with an alkali adheres to the tooth surfaces localizing after the manner of the plaque an acid corrosive substance upon the teeth surfaces." Even if true, would this apply to an

acid dentifrice without applying to ingested fruits such as apples, grapes and oranges?

There is confusion in the minds of many regarding mucin and protein in saliva—the terms are often supposed to be as synonymous as Dr. Kirk seems to consider them. Mucin is a protein, but there are several additional proteins in saliva.

For our further understanding, note again above what Pavlov says about protein and the parotid secretion. Now let me read from Foster's *Text book of physiology* (1893, p. 307):

20. "Parotid saliva contains globulin and some other forms of albumin (protein), *with little or no mucin.*"

Let me read also what Howell has recently written on this point in his *Text book of physiology* (1910, p. 726):

21. "The *parotid* is described usually as a typical serous or albuminous gland. Its secreting epithelium is composed of cells, which in the fresh condition, as well as in preserved specimens, contain numerous fine granules, and its secretion contains some albumin. The *submaxillary* gland differs in histology in different animals. In some, as the dog or cat, the secretory tubes are composed chiefly or exclusively of epithelial cells of the mucous type. In man the gland is of a mixed type, the secretory tubes containing both mucous and albuminous cells. The *sublingual gland* in man also contains both varieties of cells, although the mucous cells predominate. *In accordance with these histological characteristics it is found that the secretion from the submaxillary and sublingual glands is thick and mucilaginous as compared with that from the parotid.* . . . Examination of the separate secretions shows that the main difference lies in the fact that *the parotid saliva contains no mucin, while that of the submaxillary and especially of the sublingual gland is rich in mucin.* . . . The *parotid saliva of man seems to be particularly rich in ptyalin* as compared with that of the submaxillary, while the secretion of the latter and that of the sublingual gland give a *stronger alkaline reaction than the parotid saliva.*

Returning to Dr. Kirk's quotation of remarks by Pavlov, let me say that, if we were to assume erroneously, with Dr. Kirk, that Pavlov included mucin in the term protein (mucin being *a* protein) in the quoted statement that "acids and alkalies, *in marked distinction to all other chemical reagents*, receive (induce a flow of) a saliva very rich in protein material," then the quoted statement is incorrect in its exclusion of "all other chemical reagents." Chittenden and Richards found that "mixed saliva resulting from stimulation with ether, alcohol, etc., contains a

much larger proportion of mucin than the secretion coming without stimulation, being noticeably thick and viscid." [26]

Dr. Kirk's references to Head's findings do not help his argument. " The saliva may sometimes show violent (!) acid reaction to litmus," *without being more acid than ordinarily, so far as H-ion concentration is concerned.* Dr Kirk forgets, in this connection, his electrometric points on *actual* reaction. Dr. Head's quoted assertion, " that the saliva has decided powers of protecting the teeth from acid decalcification, that can hardly be explained by (action of?) its contained alkaline *salts,*" is a belief, not an established fact. I think the facts under ordinary conditions warrant a different opinion.[27]

If acid dentrifices cause the precipitation, as Dr. Kirk *now* appears to believe, of " an acid-mucin coagulum," which if not removed from the teeth would adhere to and corrode them, one wonders how, in 1910 and *now,* the " protective action on the part of saliva in the instances cited (in Head's experiments referred to above) was in all probability due to the action of mucin, which if present in sufficient quantity clears the saliva of acid in the same way that the acid clears the saliva of mucin, *i. e.,* by precipitation as an acid-mucin coagulum." Teeth were present in the latter case, just as in the first, and the " acid-mucin coagulum was not removed." If these views of Dr. Kirk mean anything, they imply that the teeth are in danger in the first case with an afterflow of saliva to protect them, but are protected in the latter case (Head's tests) with a circumambient stagnant. acid fluid to endanger them.

I ought also to remind Dr. Kirk that mucin *cannot* act as he suggests, since an *excess* of precipitating acid which is more powerful in corrosive effect on teeth than the precipitated mucin itself, is required to agglutinate mucin from its colloidal solution, as mucinate, in saliva. Any acidity of the precipitated mucin intrinsically, or extrinsically (*e. g.,* by adsorption), is trifling in quantity, and in its effect on teeth, compared with the proportion and influence (acidity) of the excess of the acid precipitant itself. " The power of mucin to clear the saliva of its acid con-

[26] Chittenden and Richards: *American Journal of Physiology,* 1898, i, p. 476.
[27] Lothrop and Gies: *Journal of the Allied Dental Societies,* 1913, viii, p. 311.

tent by forming an acid-mucin coagulum," as suggested in Dr. Kirk's paper in 1910 and in this one, is at best a negligible power compared with the regulating effects of this kind which are exerted by the associated phosphates and bi-carbonates.

[Dr. Kirk alludes to Bunting's support of his views on the power of saliva "to rid itself of acid" through the "precipitation of mucin as an acid-mucin coagulum," by referring in a footnote to page 285 of *Dental Cosmos* for March (1914), which was not available in New York the night of this discussion. I find nothing in Bunting's paper in support of this idea. An examination of Bunting's paper shows that he assumes indicators are unreliable and that CO_2 is a disturbing factor in determinations of salivary alkalinity. He appears to be wholly unaware of the necessity of including occurrent CO_2 in any estimation of salivary reaction-*potential*—the reaction of most significance in dental relationships. Regarding the reaction-import of CO_2 in saliva, Bunting makes the following surprising assertion, in referring to the use of phenolphthalein: "This obvously would include the CO_2 of the saliva, *in which we are not concerned,* and which would *obscure the real acidity* (!) or alkalinity of the sample tested." One wonders just what Bunting considers the "*real*" acidity or alkalinity—the *actual,* or the *potential,* or neither! Bunting is so completely oblivious to the history of indicators that he says: "It was in 1907 that Dr. Kirk first (!) pointed out the fallibility of the litmus test in an editorial entitled "The Amphoteric Reaction." This may be the date when "Dr. Kirk first pointed out" all this, but it was decades after *the fact* itself was "first pointed out" and currently appreciated.

Bunting also reveals a remarkable ignorance of biochemical literature when he writes, regarding saliva, on page 286: "We are dealing with a secretion about which there is less known than of almost any body constituent. As we search through the medical and chemical literature we find little or nothing upon the saliva and no help may be had from these sources." And dentists are expected to profit from, and be instructed by, such misinformation! Bunting states: When I added various acids to salivas which were originally acid, neutral and alkaline, I found invariably that in any case a considerable quantity of the acid had

combined with the saliva, so that the resultant acidity of the saliva and added acid was much less than the combined acid readings of each. I found that this property varied greatly in different salivas, some taking up much more than others. . . . It was not, however, dependent upon the concentration of the solids (particles?) of the saliva, for when centrifugated the thin portion (containing phosphates and bicarbonates, of course) was as active as the thick. . . . *If, however, the saliva be* dialyzed it loses its property (*all of it?*) *of combining with acids.*" What has become of the mucin with the great combining power for acid which Dr. Kirk gives it! Did it dialyze away with the phosphates and carbonates, or is it *an indiffusible substance?* Current biochemical knowledge of the composition and properties of saliva fully explains these findings, which seem to puzzle Bunting; many of the foregoing quotations indicate the explanations. The destructive bearing of these points upon Dr. Kirk's main argument, however, although mentioned in a paper to which he refers in support of his views, does not appear to have occurred to Dr. Kirk.]

I agree with Dr. Kirk that much more must be learned about mucin before its role in defense and offense, from the dental standpoint, can be fully understood. Dr. Kirk's views show, by their vagueness particularly, how much the dental profession is at sea on the subject and how great is the opportunity for discovery of chemical facts that may be of service to dentistry in the ultimate clinical determination of the function of mucin.

In his criticism of Pickerill's remarks about "ropy, *i. e.*, mucinous saliva," it is evident that Dr. Kirk forgets the facts about the variations in basicity of the mucinates in saliva and the consequent variations in colloidal character—from marked viscidity to thin fluidity. Some salivas that are exceptionally viscid, due to comparatively large contents of mucinate, are relatively low in *potential* alkalinity.

So long as "mucin" is used to designate both the glycoprotein compounds *in solution* and the corresponding *precipitated* products, misunderstandings on this point will occur repeatedly. Dr. Kirk uses "mucin" to designate both kinds of glycoprotein material. The most rational terminology in this connection is,

I believe, the use of the following terms: *Mucinate,* to designate the ion-compounds of the glycoproteins in saliva and other secretions (now commonly called "mucin") as they occur naturally and as they can be prepared artificially; *mucin,* to indicate the acid glycoprotein-acid that is preciptable from mucinate by acidification; *mucus,* to signify the familiar viscid, slimy protein *secretion* from any membrane and in any medium; and *mucous* (adjective), to suggest qualities like those of mucus.

I have been keeping an eye on that clock up there. The hands have been moving far too rapidly for me, though I am sure much too slowly for you. If there is to be time for further discussion, I must ignore the rest of the details to which I alluded a while ago.

Let me say, in conclusion, that my scientific ideals, and my sense of obligation to you who have elected me an honorary member of this society, require an expression of protest against papers of this kind that may be offered for the serious attention of this organization or of any other similar body. This paper is another of the many pseudo-chemical contributions which dentists have felt free to publish in the name of research. Animated in every case, apparently, by an ardent and commendable aspiration to increase dental knowledge, certain dentists, with misguided zeal and good intentions, have ignored the fact, nevertheless, that chemistry and dentistry are two dissimilar professions which require, in each case, particular technical skill and thorough scientific knowledge for the most successful pursuit. These well-meaning dentists have overlooked the fact that brilliant success in the one profession is not an indication of particular capacity in the other. You know that it is very difficult for an expert in either profession—dentistry or chemistry—to be consistently correct in his methods and conclusions, and to avoid inexcusable blunders. How much more difficult it is for the unskilled and inexperienced! It is remarkable to what extent the idea prevails that scientific research is a mere diversion or hobby-riding, in which any one may engage as acceptably as any other, and that special training for the work of investigation is quite superfluous.

Dentists should understand that chemical research cannot be successfully conducted today with methods described in text

books published fifty years ago, or in the light of haphazard experience gained by puttering with chemicals, or simply with good intentions. It is time for you to eye with suspicion the expert dentist who persists in taking your time, and using space in your journals, to present chemical research of doubtful validity and of dubious comprehension. Let us stick to our lasts! Let us show each other that we have respect enough for the arts and sciences to grant that all of them require for their successful pursuit quite as much knowledge and skill and preoccupation as any in which we are individually engaged.

Chemical problems in dentistry should be attacked by professional chemists. Metallurgical research in dentistry should be largely in the hands of expert metallurgists. So it is with other branches of dentistry. If trained chemists and metallurgists, for example, do not see your problems in those two fields, point out your difficulties! Call for help! I believe there are many chemists who would cheerfully respond. Scientific dentistry has advanced slowly, in its *biological* aspects, because trained biological investigators have not been attracted to the field, and also because dentists as a body have been content to swallow unlimited quantities of the pseudo-science which members of their own profession have been evolving *and have been encouraged to publish.*

I have taken the warpath, in your service, against the pretensions of your pseudo-chemists. I propose to keep the war paint on until some one " knocks me out " with a *showing* that I am wrong in drawing such deductions. In taking this aggressive position I shall surely make numerous and important enemies, but the prospect of that is in no wise discouraging—certainly not deterrent. The " hot-air " era in dental chemistry will be speedily brought to a close, if very frank criticism can accomplish it. If in the future you feel that you want discussions of papers to consist simply of verbal bouquets and the atomized rose water of personal " jollying," keep me off your programs—but if you were to invite me again to discuss a subject, I should assume that you would want me to think and speak as earnestly and effectively and judicially as I could—and I should certainly do then as I have tonight, if the paper required it.

Your flattering response to that assertion makes me feel that I must stop right here! I regret from the personal side that I have had to disagree so completely with Dr. Kirk. I am particularly uncomfortable because I have not been privileged to confront him here so that he might see, as you do, that although I am handling this matter "without gloves," I am doing so in a way, nevertheless, that is purely abstract and as broadly scientific as I can possibly make it.

You have been very good to "sit this thing through" so patiently. I hope there is more profit for you in the discussion than I am able to persuade myself any one can derive from it. My criticism has been unavoidably destructive. Knowledge has been increased in no particular. I wish we could have given our time to constructive possibilities and to the advance of dentistry.

Dr. Chayes—I would like to ask Dr. Gies a question. You showed that Dr. Kirk quoted Pavlov as saying that an acid would stimulate the flow of saliva and make that saliva rich in protein and mucin, and then you quoted Chittenden and showed that he said the saliva stimulated by acid contains a lot of mucin.

Dr. Gies—The point is that Dr. Kirk proposed to substitute the idea of mucin for the idea of protein in the quotation from Pavlov's book. To this I have objected because such a substitution is rendered impossible by my own direct quotation from Pavlov's book on the mucin point, which indicates that acids stimulate an abundant flow of saliva that is *poor* in mucin. I quoted Chittenden and Richards to the effect that a number of substances stimulate a flow of saliva that is rich in mucin, but I didn't say they stated that acids cause such a result.

Dr. Chayes—I thought you quoted that to call Dr. Kirk wrong, and that is why I brought it up.

Dr. Gies—I fear that you have not caught the point. That was exactly why I *did* quote and comment as I have in this connection.

Dr. Chayes—Is it not just possible that Dr. Nash did not read all of the paper, and that the parts he left out caused it to be misunderstood and misleading?

Dr. Gies—My criticism pertains to the paper as I myself

read it this afternoon before it was turned over to Dr. Nash. Dr. Nash omitted nothing but the tables, and they were passed among you for examination.

Dr. Kirk, in Closing the Discussion—Dr. Gies has done me the honor of saying that "a great stream of important literature passess continuously through my editorial brain." I do not wish to accept his complimentary reference without some qualification, but as a matter of fact what he has said in that regard is, in the main, true; and I wish to add that of all the stream of important literature which has passed under my inspection during an editorial experience of twenty-three years the exhibit made by Dr. Gies in his reported discussion, while it may easily be classed with the most important communications that I have been called upon to examine, it is likewise the most remarkable in a number of other respects.

I should have been more than glad to have been able to avoid any personal reference whatsoever in connection with discussion of the topic of my paper, but as the personal factor has been so largely introduced into the discussion by Dr. Gies, I have no recourse other than to take up that phase of the subject upon the terms of combat which he himself has laid down. I do this the more willingly, however, because Dr. Gies in justification of his introduction of the personal factor into his critical analysis of my paper prophesies that his particular technique of debate, if generally adopted, will bring the "hot air era in dental chemistry speedily to a close," a consummation which he can certainly wish for no more devoutly than I do myself.

I am driven to the conviction from a fairly close study of the reported discussion by Dr. Gies that he is arguing under the domination of an *idée fixe*, namely that dentists, because they are dentists, have neither a moral right not scientific justification for dealing with any of the problems of chemical research or of metallurgical research or with research in some other branches of dentistry. The whole tone and atmosphere of his reported discussion reeks with resentment toward the dentist whose "good intentions" or whatever motive may lead him to encroach upon the territory of professional activity which Dr. Gies claims as his own. This kind of attitude is much more ancient than any

of the recorded data with reference to the subject of my paper, which Dr. Gies chides me for not referring to and charges me with not knowing about. Upwards of two milleniums ago certain critics, animated by what appears to have been quite the same idea, inquired as to the possibility of any good thing coming out of Nazareth. Well, it did. The motif and the texture of Dr. Gies' debate strongly suggests an hereditary influence, if not an origin, running back or related to an environment somewhere "over against Nazareth."

Now, let me point out a few features which will serve to emphasize the truth of Dr. Gies' statement as to how difficult it is "for an expert in either profession, dentistry or chemistry, to be consistently accurate in his methods and conclusions and to avoid inexcusable blunders." I may as well state them serially.

In the first place let me say as emphatically as possible that when in my paper I expressed the opinion that our knowledge regarding the reaction of the saliva needed fundamental revision, I did so in the light of the fact that I was addressing a dental audience, and the possessive pronoun "our" used in that sentence is intended to apply to the knowledge of the subject possessed by the dental profession. I was speaking as a dentist to dentists, and I regret that Dr. Gies felt for one moment that I regarded it necessary to revise his knowledge of anything chemical.

I have not "overlooked the fact that brilliant success in one profession is not any indication of peculiar capacity in the other." I recognize the fact that "chemistry and dentistry are two dissimilar professions which require in each case particular technical skill and thorough scientific knowledge for their successful pursuit." I do not believe, however, that because a man is a dentist, that he, for that reason, is incapable of knowing something of chemistry and vice versa. This vice versa I add for the particular encouragement of Dr. Gies in his study of dental problems. I have long known that "muc*us*" is a noun and that "muc*ous*" is an adjective. That information can be found in most dictionaries, and I well remember the occasion when I first learned the difference some forty-five years ago. I have known for about fifteen years that the substance "now commonly called mucin is a glyco-protein," and I have known for a less period

that its molecular construction was such as to justify its designation as a mucinate. I never laid claim to the discovery of the amphoteric property of the saliva, but I have called attention to it, perhaps in my role of propagandist of things that I think dentists ought to know. I never claimed to have discovered the fact that phosphates exist in the saliva.

Dr. Gies seems to have had some pleasure in destroying what he has assumed to be my claims to being the originator both of the discovery of phosphates in the saliva and the amphotericity of the saliva. I have done nothing nor said nothing to warrant such an inference. He has applied the term "fantastic" to some suggestions that I have made. I have carefully re-read my paper and I find in it no more fantastic suggestion, nor any quite as fantastic as this figment of his own imagination which it has apparently given him so much pleasure to demolish. The use of the word "proven" in connection with the existence of phosphates in the saliva, and which Dr. Gies has inferred was a claim of discovery is merely the usual phraseology to indicate that phosphates existed in the particular sample of saliva under investigation, and to check up that fact already known, and which, as Dr. Gies has shown, is widely published in the literature of the saliva. A similar and unwarranted perversion of the meaning of my paper is the effort made by Dr. Gies to show that I have assumed that Pavlov, from whom I have quoted in my paper, included mucin in the term protein. My paper makes no such statement, nor anything that can be twisted into such a conclusion. The inclusion of mucin as protein material is my own. I may be erroneous in so including it, but even Dr. Gies himself in his reported discussion states that mucin is "a protein" and refers to it elsewhere as "glyco-protein." I am unable yet to see from anything that Dr. Gies has said that Pavlov meant to exclude mucin when he made the statement which appears quoted from him in my paper.

I wish to correct an error of reference to which Dr. Gies has called my attention, namely, that my quotation from Pavlov is from the "American edition," for as a matter of fact it was from the second English edition, "being the sole authorized English translation by W. H. Thompson, London; Charles Grif-

fin & Co., 1910." The word American instead of English was a slip in dictation.

Dr. Gies seems to have had much pleasure with another one of my "fantasies" regarding what I have stated about the precipitation of an acid mucin coagulum. First of all he objects to the term coagulum. I grant that the term coagulum is lacking in descriptive precision to designate the precipitated mucin, and I used the term mucin in this instance as Dr. Gies suggests that it should be used "to indicate the acid glyco-protein acid that is precipitable from mucinate by acidification," but I am unable to find a more descriptive term. Coagulum as defined by Dorland and others is a clot or curd, and as the composition of the mucinate of Dr. Gies and its behavior towards acids bears fairly strong analogies to the basic combination of casein in milk, the use of coagulum in its etymological sense to describe at least in a physical sense the precipitated "acid glyco-protein acid by acidification" of Dr. Gies' mucinate does not seem to me to be open to criticism other than hypercriticism.

Dr. Gies has, I believe, accepted as reasonably sound my theory of mucinous plaque formation. Indeed, if I remember correctly, I have somewhere a letter from him expressing his approval of that point of view and stating that he had intended to announce it himself but that I had preceded him, and congratulating me upon my having done so. I make this statement only from memory and without the documents before me. It is therefore subject to the qualification that my memory is not infallible.

Dr. Gies will I think concede that the mucinous plaque ought to at least represent quantitatively an acidity considerably beyond the normal acidity of his "acid glyco-protein acid" of which it is mainly made up, because of the excess of acids produced by the fermentative bacterial activities taking place within its mass. So also when mucin (Gies) is precipitated from a solution of its mucinate (Gies) by an excess of the precipitating acid, e.g., acetic, it is a matter of no little difficulty to wash out the excess of acetic acid (the precipitant) from the coagulated mass of precipitated mucin (Gies). That is to say, in the case of the mucinous plaque and in the case of the mucin precipitated by

acetic acid, the acid excess in both instances becomes mechanically entangled with the mucin (Gies) and is not readily washed out. I am not aware that the quantitative relations between ingested acids or of acids formed in the mouth by fermentation or by acids the products of faulty metabolism which find their way into the mouth through the salivary mucous secretions are always quantitatively balanced with respect to the salivary mucinates in their respective molecular ratios.

I have read with intense interest and with profound admiration the work of Pavlov and of Pickerill and of Gies and other writers on the subject and have been particularly impressed, especially in the case of the first author quoted, with the remarkable and beautiful physiological mechanism by which certain types of stimuli call forth a physiological response upon the part of the salivary glands in which the secretion appears to be modified both in composition and quantity in direct relationship to the respective stimuli. Nevertheless I have found nothing to indicate that this remarkable physiological mechanism is in all instances able to maintain compensatory relations between acids and alkalis in such a way as to at all times protect the dental structures from the corrosive or disintegrating effects of acid contact. There are, and be it understood that I speak now as a dentist and not as a chemist, undoubtedly conditions in which precipitations of mucin occur upon the teeth which if allowed to remain as such, that is to say, if not neutralized or physically removed, exert a corrosive and disintegrating effect upon the subjacent tooth structure. When blue litmus paper strips are applied to such areas, the blue is turned to red, and notwithstanding the known defects of litmus as an indicator, we conclude that the areas are acid, a conclusion still further confirmed by the disintegration of the subjacent tooth structure.

I am not ready to accept the statement of Dr. Gies as a chemist that "traces of the anion of the acid employed for the purpose (precipitation of mucin) may be easily flushed out of the precipitated product" in any sense in which that statement may apply to the precipitation of mucin as it takes place in the mouth, and then again what Dr. Gies may have in mind when he says "easily" needs elucidation. Dr. Gies apparently does a

number of things "easily" that other less favored individuals do with difficulty. For example, one may say that all traces of a hyposulphite fixing solution may be "easily" washed out of a photographic gelatine plate, yet as a matter of fact the colloidal gelatin retains the fixing salt with considerable tenacity, and to wash out the last traces to a point that would satisfy the chemical and scientific ideals of Dr. Gies, would not in the ordinary sense, time, labor, and water considered, be done "easily." The analogies between the example cited and that of the physical retention of an excess of the precipitating acid by the mucin precipitate are fairly parallel.

Dr. Gies states, as a chemist I presume, certainly not as a dentist, that "dihydrogen sodium phosphate in the proportions in which it occurs in saliva is apparently devoid of any destructive effect on teeth and fails to precipitate mucin from the saliva or from a neutral solution of salivary mucin. This statement does not apply to preparations of dihydrogen sodium phosphate containing phosphoric acid." I should like to ask Dr. Gies first in just what proportions does dihydrogen sodium phosphate occur in saliva? The dihydrogen sodium phosphate which is most destructive to teeth is that which is contained in the exudate from certain localized and disordered mucous glands in the cases of faulty metabolism in which so-called chemical erosion of the teeth is frequently a notable symptom. It is this exudate that is destructive to tooth surfaces before it becomes mixed with the saliva. I have not attempted to determine the extreme limit of dilution at which solutions of dihydrogen sodium phosphate will exert a corrosive effect upon the enamel, but certainly in extremely dilute solutions the disintegrating effect of dihydrogen sodium phosphate upon enamel structure is easily manifest. I note the qualifying statement with which Dr. Gies guards his position on this point, by saying that it "does not apply to preparations of dihydrogen sodium phosphate containing phosphoric acid." My own experiments in this particular were made with Kahlbaum's preparation of dihydrogen sodium phosphate, guaranteed by the manufacturer to be chemically pure.

Hugounenq, Précis de chemie Physiologique et Pathologique, Collection Testut, 1897, states, page 500, after discussing

the precipitation of mucin by various acids, "Le Phosphate monosodique $H_2Na\ PO_4$ précipite egalement la mucine." This of course is open to the suspicion that Hugounenq may have unfortunately purchased his "phosphate monosodique" from Kahlbaum as I did.

Whether his remarkable statement as to the behavior of dihydrogen sodium phosphate toward tooth structure and toward mucin respectively is simply an *ipse dixit* or is based upon experimental evidence, Dr. Gies does not explain, but it is certainly out of accord with such experimental evidence as has thus far been brought forward in relation to the question at issue and is also out of accord with what one might reasonably expect from the nature of the factors involved.

Dr. Gies writes a reaction between one molecule of trisodium phosphate and one molecule of hydrochloric acid obtaining thereby one molecule of hydrogen di-sodium phosphate and one molecule of sodium chlorid, as a refutation of my statement of inability to write such a reaction without its coming out acid at the end. I would like to ask him what explanation he has to make of the potentiality of the hydrogen ion in his hydrogen disodium phosphate resulting from the reaction? He will surely agree that if he had used two molecules of hydrochloric acid, or any di-basic acid in this reaction, it would have come out acid in the end, or if not that, then if he had used three molecules of hydrochloric acid or any tri-basic acid, he would have come out acid at the end, assuming each case that the reaction would take place at all. In the light of the hydrogen ion to which I have referred in his reaction, and in the light of his lucid electrochemical explanations of the meaning of acidity, basicity, and neutrality I can only regard his solution of my equation problem as at once plausible and specious—a type of critical analysis running throughout the discussion quite in harmony with his *idée fixe* that all dentists who invade the domain of chemistry must be "handled without gloves" for their impertinence.

Dr. Gies has devoted much care and attention to elucidating the limitations to the use of various indicators and to the value and relationships of the electro-metric method for determining reaction. I am extremely grateful to him for his elaborate and

lucid presentation of that phase of the subject, for it serves to emphasize what after all is the main contention in my paper and the purpose of its preparation, viz., to call attention to the utter valuelessness of the reports that have heretofore been made upon the reaction of the saliva at least in so far as such reports are based upon the use of a single indicator. I believe that with respect to that point of view we are in agreement. I refer in this conection not to the precise work done in the laboratories of expert physiological chemists on individual salivas, but in the clinical reports of the dental profession. I am inclined to view with suspicion also the reports of reactions of the saliva made by expert physiological chemists from the laboratory standpoint inasmuch as they are representative only of the reaction of the particular individual case at a given time and to a given indicator, the mutability of the saliva as to composition in different individuals and in the same individual at different times being a generally recognized fact. Similar criticism is applicable generally speaking to the average or usual clinical reports of the reaction of the urine.

I do not feel it incumbent upon me to deal with the criticisms which Dr. Gies has felt it necessary to import into this discussion with reference to the writings of Dr. Bunting and of Dr. Head. I believe that the views of the so-called alkalinity or acidity of the saliva as expressed in dental journals and by Dr. Pickerill need fundamental revision; that the observations of the reaction of the saliva based upon the use of the ordinary indicators by the ordinary dental investigator are of questionable value and for comparative results of the determination of the actual reaction are useless, and that the precipitation of mucin by acids and in general the "potential and alkalinity of the saliva must be more fully and carefully investigated before any generalization as to dentifrices can be made." The authors quoted by Dr. Gies to prove that the "actual alkalinity" of saliva is a well known fact, do not change the truth of the statement that dental investigators need to revise their notions of salivary reaction from their ignorance of the work cited or from having drawn different conclusions from their experiments with indicators. Dr. Gies himself brings out the fact that solutions of Na_2HPO_4 and Na

H_2PO_4 vary little in reaction, but I have failed to find any modern authority which will state that the points Na H_2PO_4 and Na_2H PO_4 can be accurately determined by the use of indicators. The physico-chemical reason for this is shown by the results of Hildebrand (The H^+ Electrode in Analysis and Teaching). "The factor of error" is always present when dealing with solutions such as those of the mixed phosphates when considerable additions of acid or alkali produce but slight changes in the H^+ ion concentration.

Dr. Gies states that the electrometric acidity, etc., of biological liquids, including the saliva, may also be accurately determined colormetrically with indicators. Although this method has been and is widely used, physical chemists are inclined to question it for the following reason: Although it is possible to determine the acidity of salt solutions in which the indicator is dissolved and the whole brought to a definite dilution, by comparison with tinctorial standards of know H^+ concentration, this method cannot be used for accurately determining the H^+ concentration of biological liquids unless the very dangerous assumption is made that the H^+ ion concentration varies directly with the dilution, for an indicator cannot be introduced into a biological solution without decreasing its concentration. There appears to be lacking any experimental evidence to prove that the indicators themselves do not unite with some of the organic constituents of these liquids, thus vitiating the results. While it is true that the identity of the H^+ ion concentration of two solutions can be established by the use of indicators, it does not follow therefrom that the H^+ ion concentration of a biological liquid can be measured by diluting it and proving the identity of this dilute liquid in H^+ ion concentration with some liquid of known H^+ ion concentration.

The work of my collaborators on this paper has developed the idea that there is a difference between the actual (ionic or electrometric) alkalinity and the potential (titratable) alkalinity, a conclusion which Dr. Gies apparently strengthens by his additional evidence.

I am quite sincere when I say that I consider that I have been fortunate in presenting a paper which has served so ef-

fectively as a target for Dr. Gies' criticism, for it has furnished him opportunity to present in comprehensive form a mass of information which cannot fail to be of utmost importance to the dental profession. I regret extremely that he has made his presentation from the narrow viewpoint of what strikes me as being dangerously near a sort of scientific or professional trade-unionism. I have the most profound admiration for the abilities of Dr. Gies and the splendid work that he is doing, but I regret that the presentation of it has more than once been marred by a " Sir Oracle " attitude which permits no dental dog to bark in chemical tones or terms.

He has indulged freely in the use of the terms " pseudo-science," " pseudo-scientific," etc., to express his disapproval of any attempt to encroach upon what he seems to regard as his particular scientific preserve, and he justifies that attitude by reference to his high scientific ideals and his loyalty thereto. One may well question whether such an attitude is after all, broadly speaking, really scientific, for isn't a persistent unwillingness to accept the truth, yea, even though it should emanate from a dental Nazareth, perilously close to the pseudo-scientific?

Adjournment.

FREDERICK C. KEMPLE, D.D.S.,
Editor, First District Dental Society.

ADDENDUM BY DR. GIES.

As I stated on page 289, the editor's courtesy in sending me galley proofs of Dr. Kirk's reply to my criticism of his paper, *after* the return of my own corrected proofs, has led to the discovery of a number of points on which I have requested the privilege of commenting briefly. I desire to refer to the few remarks by Dr. Kirk which imply doubt in his mind regarding a number of points at issue.

I do not recall whether I ever wrote to Dr. Kirk congratulating him upon his " theory of mucinous plaque formation," but his recollection of the matter must be correct. I am glad he introduces this point, even though it is irrelevant, because it shows exactly how much there is in his foolish assertions about " persistent unwillingness to accept the truth, yea, even though it should emanate from a dental Nazareth." As a further indication of such "unwillingness to accept the truth," or to give " credit where credit is due," I quote the following from a paper by me in this Journal (June, 1912, p. 210): " When I expressed this opinion (about

mucinous plaque formation as a factor of importance in the initiation of caries) I fancied it was a new view of the matter—at that time (1909) I had assimilated very little of the literature of the subject. *I was deeply gratified to find,* a few months later, during the progress of the ensuing investigation, that your distinguished colleague, Dr. E. C. Kirk, of Philadelphia, had formulated this theory in some detail."

When I say that "traces of the anion of the acid employed for the purpose (precipitation of mucin) may be easily flushed out of the precipitated product," I mean merely that it is a matter of ordinary ease to wash, by decantation, all of the precipitant from the product. This is a *routine* achievement in the purification of mucin preparations.

My remarks, to the effect that "di-hydrogen sodium phosphate, *in the proportions in which it occurs in saliva,* is apparently devoid of any destructive effect on teeth and fails to precipitate mucin from the saliva or from a neutral solution of salivary mucin," were based on direct observations. The experiments have been in progress for some time. The results will be reported in detail before this society next fall. Dr. Kirk has overlooked the word "*apparently*" in my remark. I spoke from knowledge then in the process of evolution. The "proportions in which di-hydrogen sodium phosphate occurs in saliva" are small and variable, and, of course, are less than the proportions of total inorganic matter—for which Dr. Kirk has given some data. Our experiments in this connection have been performed with proportions both smaller and larger than the salivary maximum.

My references on page 289 to Dr. Kirk's predicament regarding the use of an illustrative equation showing how a free acid can be neutralized by a phosphate "without such reaction coming out with an acid at the end," answer all the questions Dr. Kirk asks in this connection on page 306.

I have confined these selections to the matters in which Dr. Kirk appears to have been uncertain regarding the import of my statements. I have done so in the desire further to elucidate this discussion. I hope I may be permitted to add that I regard Dr. Kirk's personal references as the natural result of an irritation I am sure I should myself feel if I were in his place; but since they relate to my temperament and not to my competency to discuss Dr. Kirk's paper, his personal allusions are obviously irrelevant.

I rely on the readers of the Journal to compare carefully the comments on the special points at issue—such as those on the Pavlov matter. I also assume that every reader will note that I have said nothing whatever in discouragement of any effort by any dentist to *qualify* himself to speak with authority and effectiveness on any subject in chemistry. I have protested against the *presumption* of ability and knowledge in chemistry in the public discussion of chemical problems, not against the exhibition by any one of capacity or learning in the field in which I am

but one of thousands who find it happy to labor. Are dentists inclined to listen to instructions in dentistry from lawyers, preachers, paperhangers or plumbers? Naturally if some dentists wish to entertain themselves with pseudo-chemistry, they must be privileged to do so. I have shown frequently, in private and in public, that I entertain high respect for dentistry as an art, a science and a profession, and I resent Dr. Kirk's unworthy effort to arouse dental prejudices by reading anti-dental sentiments into what were only anti-humbug remarks.

Dr. Kirk makes an artificial protest against an implied unwillingness on my part "to accept the truth, yea, even though it should emanate from a dental Nazareth." Who can find any *truth* that has emanated from the "dental Nazarene," in the foregoing paper, that I have been unwilling tó accept? *I have been protesting against error, not against truth! That* has been my dominating *"idée fixe"!* I am sure those who heard the discussion *saw* that!

THE JOURNAL OF THE ALLIED DENTAL SOCIETIES

WILLIAM B. DUNNING, D.D.S., *Editor*
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EDITORIAL DEPARTMENT

OUR BEGUILING ENTHUSIASMS

A dental radiographer, who is doing valuable work, recently made the remark that the radiograph would be a good means of ascertaining the degree of finish of the invisible gingival margin of a proximal filling. The suggestion is interesting as indicating a tendency of the times—namely, a growing dependence on elaborate means toward ends within easy reach. The operator who has been accustomed to thinking at the end of a fine explorer could answer this question with

certainty, and in thirty seconds, where the radiograph might mislead through the superimposition of shadows so commonly to be dealt with in reading films. In many practical matters a dollar watch is more useful than a solar observation.

Eighteen or twenty years ago "everyone" rode a bicycle; now the bicycle, minus the fad, is serving a useful and inconspicuous purpose. Our technical advances bring their fads, and while the fad "is on," much unbalanced judgment may be found in otherwise well-regulated practices. In the early seventies the best minds in our profession were perverted by the magnetic personality of Dr. Robert Arthur, who (in good faith and from honest conviction) recommended the wholesale filing away of proximal surfaces as a preventive of dental caries. Men of such soundness of judgment as the late Dr. S. G. Perry became enthusiasts for a brief season; but the fallacy of that extreme doctrine was soon exposed, and our leading men rapidly recovered their equilibrium.

In recent years we need only recall the advent of cataphoresis, the porcelain inlay, the casting process, nitrous-oxid and oxygen analgesia, among many others, to see these waves of popular enthusiasm rising over a new and valuable idea, and then subsiding to leave the invention or discovery where it really belongs on the wide beach of useful knowledge.

Our debt is heavy to the men who undertake the thankless work of bringing into material being "the stuff that dreams are made of." The present views are not addressed to them: we could not advance without their inspiration and, perhaps, their fanaticism. Human-like, we shy at a new thought, and then chase it to

earth. But we, the plodding, common-sensed practitioners, must cultivate the faculty of judging coolly, from the broad view, if we are to render our best and most lasting service to mankind.

An instructive controversy has been going forward of late in the *Items of Interest*.[1] Drs. Ottolengui, Young and Gillett show with much force and clearness the advantages of the carved inlay in restoring occlusal surfaces and proximal contours. Dr. Ottolengui prophesies a revolution in operative dentistry, based upon Dr. Young's paper. Dr. Gillett sums up his belief in the statement that the operator of the future, in restoring the normal shape and efficiency of teeth, and in making his choice of material, "so far as can now be foreseen . . . in occlusal or proximal cavities, be they large or small, for patients old or young, [it] will fall upon the cast gold inlay."

Dr. C. Edmund Kells in answering Dr. Ottolengui's original editorial takes what may be called the conservative view, and makes a strong plea for the now almost lost art of filling small cavities with non-cohesive gold. The burden of his argument is against wholesale cutting of teeth for elaborate inlay restorations where the foil filling may be used advantageously. Of course such a discussion is endless, and our space will admit of but a few general considerations.

Undoubtedly lost occlusal surface of considerable area should be restored to correct form as nearly as may be consistent with permanence. The superiority of the inlay method for this purpose is beyond ques-

[1] Our readers are referred to this interesting series, beginning, *Items of Interest*, Vol. XXXV, 1913, p. 384. Dr. Young's paper appeared originally in THE JOURNAL, Vol. VII, 1912, p. 190

tion, and is not questioned by Dr. Kells. But Dr. Kells, the present writer, and thousands of other observers have noted ancient "soft-gold" fillings in the mouths of elderly people—at the bottoms of sulci, and so small as to be inconsiderable in relation to tooth shape. Incipient caries was stamped out of those crowns forty or fifty years ago, and the *natural* cusps, unimpaired in strength, and altered only by attrition, serve in the place of large restorations which in other mouths, or in other teeth in the same mouths, have become necessary by neglect of these minute fissure cavities. Of the two forms of service—the early discovery and perfect filling of small cavities, and the elaborate restoration of neglected occlusal surfaces—there can be little room for dispute as to superiority.

The little filling is made *perfectly* in fifteen minutes or less. The present writer uses many inlays, and believes himself conversant with the possibilities of inlay technique, but it is his deliberate opinion that no inlay nor any other kind of filling can equal in permanence the "soft gold" filling, when correctly made. This means not a rough, pitted, unwelded plug, but dense, bright and polished metal, not to be distinguished for surface hardness from malleted gold.

A cohesive foil filling in a lower first bicuspid involving the mesial or distal surface may often be made without cutting through the transverse ridge. When the inlay is used here, much more cutting is needed to secure retention. It is needless to enumerate other situations where small foil fillings serve best in the long run. In brief, the foil filling is unsurpassed for many small cavities; it is no longer indicated for large

restorations. The accomplished operator should be ready for either method.

It is a melancholy fact that in learning to make inlays men have forgotten the art of manipulating foil, and that the students of to-day believe they need never learn the use of pluggers. The cast gold inlay has brought a new era in operative dentistry; our boundaries of usefulness have been enlarged; but, with all respect for the danger of prophecy, the writer predicts a wholesome reaction, in the near future, from the present extreme views of our enthusiastic leaders.

Dr. Ottolengui devotes an entire editorial to show us how rare is "the perfectly good amalgam filling." He might have shown us with equal success how rare is the perfect inlay—or rather, how far from ideal treatment is every method of mechanical restoration. It is all patchwork, of course; some patches being "good," others "bad." The excuse for any restorative work lies in its necessity; it is so much better than nothing. The simple fact remains that countless thousands of teeth have been saved and made useful members through the use of amalgam.

Dr. Ottolengui states: "All honor to the pioneers for their success in saving teeth when the saving of teeth was the paramount object of dental service." We credit Dr. Ottolengui with having in view the fact that the dentist of to-day is looking beyond the teeth themselves, in their important relationship to the general health of the patient. But, after all, has the "saving of teeth" become a secondary consideration, or, rather, can that ever cease to be our paramount care? Of course we refer to saving the teeth ***in health,***

by early and constant watchfulness, *not* the retaining of teeth that have become dangerous to health. We submit that the saving of teeth in health is the highest service the dentist can render his patient.

Without enthusiasms this would be a sorry world. But in our professional duties let us steer mid-channel, with such wisdom as may be given us.

CORRESPONDENCE

[While regretting the personal strain which runs through certain passages in the following letters, the Editor believes them to be of interest, historically, because of the importance of the topic under discussion. For the integrity of dental literature and with a view to "fair play," they are published in full, without bias or opinion on the part of THE JOURNAL.]

UNIVERSITY OF OTAGO.

New Zealand, February 5, 1914.

To the Editor, JOURNAL ALLIED DENTAL SOCIETIES:

DEAR SIR: Perhaps Dr. Gies will forgive me the platitude that "there is nothing new under the sun." Hippocrates about 300 years B. C. stated "One pounds dill and anise-seeds, two oboles of myrrh; one immerses these substances in half a cotyle of pure white wine; one then rinses the mouth with it, holding it in the mouth for some time." Celsus advised as a mouth wash "the scrapings off a stag's horn in vinegar, or figs in mulse (wine and honey), or in vinegar and honey." The only point of interest, of course, is—*why?*

I regret that Dr. Gies should have taken so much of his time to show that my shaft (if shaft it could be thought) had hit a mark at which it was never aimed! May I assure you, sir, how much I admire Dr. Gies's most valuable work, and how delighted I am that a man of his caliber should be so interested in the subject as to devote so large an amount of his laboratory work to the elucidation of the problem of dental caries. So much the more do I regret that I have not been able to obtain either the back numbers of this JOURNAL containing all Dr. Gies's work from you, sir, nor reprints from Dr. Gies himself. (I wrote requesting either or both, and if they were sent I did not receive them.) This omission most unfortunately will—in my opinion—considerably mar the second edition of my book now in the press, as it was impossible to wait for another two and a half months which a second request would have meant.

Again expressing my personal thanks to Dr. Gies and his collaborators for the excellent work they are doing, I am,

Faithfully yours,

H. P. PICKERILL.

COLUMBIA UNIVERSITY,
DEPARTMENT OF BIOLOGICAL CHEMISTRY.

New York, March 25, 1914.

DEAR DR. DUNNING:

I thank you for the copy of Professor Pickerill's letter, dated February 5, 1914, in which he refers, in a general way, to some of my published comment.[1] It is a pleasure to note that Professor Pickerill has accepted my criticism in the spirit in which it was offered, although he has refrained from alluding, in his rejoinder, to the essential points at issue.

[1] Lothrop and Gies: *Journal of the Allied Dental Societies,* 1913, viii, p. 316.

Professor Pickerill regrets that I took so much of my time to show that his "shaft had *hit* a mark at which it was never aimed," but he seems to have overlooked my statement (p. 318) that, many of my dental friends having good naturedly asked me to consider my published allusions to Professor Pickerill's work as the target at which his shot was fired, I "accordingly accepted it with equal good humor as an *intended* (!) 'hit.'" If Professor Pickerill would read very carefully my comment on that page, he would see that the few minutes I took to show that his "shaft had *hit* a mark *at which it was never aimed*" was devoted solely to the demonstration that the "shaft" was a *boomerang* and the "mark" was in New Zealand.

I regret that the reprints I had the pleasure of forwarding to Professor Pickerill, at his request, were not delivered to him. A second request would have elicited a second response. I am forwarding another set to him, with great pleasure. I am glad to assure Professor Pickerill, and those of your readers who may purchase copies of his book, that his failure to mention the results of the work Dr. Lothrop and I have been doing will in no degree "mar the second edition." Our observations are in a transitional state: if they should be confirmed by further work, the *third* edition could present the results acceptably; if they should not be thus confirmed, the third edition would require so much less "downward revision." Meanwhile, dentistry is safe!

It is particularly agreeable to read what Professor Pickerill writes on the antiquity of the use of vinegar as an ingredient of dentifrices. He has had no means of learning that the substance of the facts he cites, and of many similar ones, has been discussed informally at, or after, each of the dental meetings before which our chemical reports have been presented (since October, 1911). No one seems to be inclined to pay special attention to such old records on this particular subject because the "*why*" in the ancient use of vinegar as a dentifrice is a matter of uncertainty. My latest public comment on this subject was an allusion, in concluding my remarks at the last annual dinner of the First District Dental Society, on January 24, to the statement by Dr. Thomas Cogan three hundred years ago (in *1596*), to the effect that a mixture of vinegar and rose water is an excellent dentifrice. That statements of this kind about vinegar recur in medical and dental literature from the time of Hippocrates is very significant, in view of the fact that there are apparently no recorded *observations* of any disadvantages from the use of such food-acid media as *dentifrices*.

Let me remind Professor Pickerill and the readers of your journal that I have drawn attention several times during the past two years to the fact that food-acid media had been recommended as dentifrices before I proposed such employment of them in 1909. At that time I was not aware of the fact, however. Last October I indicated that possibly Wallace, unlike Hippocrates, Cogan and their successors, anticipated also the "*why*" of my proposal. My papers in these and all other relations show

that I have consistently endeavored to "give credit where credit is due."

May I add, by way of further reminder, that the main point in my proposal of the use of food-acid media as dentifrices was the *belief* that they might be useful in "keeping the teeth clean," by effecting, in particular, the chemical precipitation of mucin from adherent mucinate smears or films on the teeth, thus causing the disorganization of such plaques and also facilitating the mechanical removal of the flocculent, non-adhesive mucin? I have also thought that the solvent action of such media on "hard tartar" might be advantageous as a cleansing process, and that their acidity might be serviceable in the treatment of pyorrhea. At the time the general proposal was offered (1909), I *assumed,* of course, that "keeping the teeth clean," in a special *artificial* manner, is an essential condition of oral prophylaxis, under the prevailing dietary conditions. I have repeatedly stated my conviction that these *beliefs* and this *assumption* need thorough testing, especially by dentists from *clinical* standpoints, before a decision can be rendered. Vinegar, as I have often said, was selected for our preliminary studies because it may be conveniently obtained and kept; but also *because its comparatively high degree of acidity renders its use less favorable to the experimental establishment of my main proposal than would be the case with a food medium of weaker acidity.* In brief, I have been investigating a radical proposal in a conservative manner.

I have never suggested that vinegar, or any food-acid medium, is or can be a "cure all"—I have proposed merely that the teeth may possibly be "kept clean" with it. That such a food-acid medium might be most effective if used only now and then, or before or after the application of an alkaline dentifrice, has been occasionally suggested in my informal statements on this subject; just as I have indicated the probability that food-acid media might be wholly unsuitable as dentifrices in various types of cases, *e. g.,* erosion. (These matters require *investigation,* not decision by intuition. We are not proceeding as rapidly as might be desired, in these directions, with learned statements as to "what's what," because we are going to *find out first* and explain afterward.)

I have repeatedly said that I cannot believe that "keeping the teeth clean" is the only, or even (in many cases) the main, *desideratum* for the prevention of dental caries. The intrinsic quality of the teeth themselves, I have often urged, must be considered. Several years ago I referred in this connection to Erdheim's work—work showing the dependence of the condition of the teeth upon the nutritional state of the individual.[2] Last May, and again in October, I alluded to similar facts. Besides proceeding with our studies of food-acid media, a clear indication that I feel that much more must be learned in this regard, we have also been conducting experiments on the *relation of internal secretions to the condition of the teeth*—a nutritional investigation in progress under the auspices of the Dental Society of the State of New York.

[2] Gies: *Journal of the Allied Dental Societies,* 1912, vii, p. 214.

I hope the second edition of Pickerill's book will give due attention to such nutritional facts pertaining to the teeth as may be found in the papers by Erdheim, Kranz, Fleischmann, Turner, Vasale and Generalli, Gley, Toyofuku, and many others—data which Pickerill ignored in the first edition, but which cannot be omitted from a thorough general treatment of the subject of dental caries.

Yours sincerely,

WILLIAM J. GIES.

150 HARLEY STREET, LONDON, W., April 23, 1914.

To the Editor of the JOURNAL OF THE ALLIED DENTAL SOCIETIES:

DEAR SIR.—In last December's issue of THE JOURNAL OF THE ALLIED DENTAL SOCIETIES, Professor Gies and Dr. Lothrop have kindly made allusion to certain views in my book, entitled "Supplementary Essays on the Cause and Prevention of Dental Caries," published in 1906.

With regard to their two interpretations of my statements concerning the precipitation of mucus with acids, I think it is easy to make it clear that their first interpretation of my meaning was correct, for a reference to pages 96-100 of my first book on "The Cause and Prevention of Decay in Teeth," and further reference to the *mucous coating* in the book from which Drs. Gies and Lothrop quoted ("Supplementary Essays on the Cause and Prevention of Dental Caries," page 40), show clearly that there was no ambiguity in my meaning. What is, I think, striking is the peculiar similarity of my views and theirs on this particular point, notwithstanding our having come to them independently and in a totally different way. I am sorry to say, however, that I do not see the same agreement in our views with regard to the rôle of the mucous coating in the causation and prevention of caries when acid does not enter into the dietary, although as far back as 1900 I invoked the aid of its property of disintegration to explain its continual removal ("Decay in Teeth," page 99). With regard to the protection which I suggested that the precipitated mucus exercised against the action of the acids in the food, it must be remembered that at the time of writing, more especially, I had two things to do: firstly, to explain why the acids in food during their passage through the mouth would do no harm to the enamel, and, secondly, to account for the clinical fact which I had observed that acid foods kept the teeth clean and relatively free from the mucous coating.

With regard to their allusions to Professor Pickerill's work, I am in entire agreement with what they say in their last communication. Dr. Pickerill would have done more good for the cause and the honor of scientific investigation had he honestly stated that his work was confirmatory of my conclusions, *and the data on which these conclusions were based,* than in trying to make it appear that the views which he expounded *originated* in his own brain or from his own work.

Dr. Pickerill apparently recognizes that priority is justly prized except by those who never had an original idea. It is recognized that it is peculiarly difficult to discover the cause of anything when we do not know

what it is or where to look for it. It is generally a relatively simple matter to make experiments which will corroborate a correct view. Indeed, it seems to me that Dr. Pickerill has that all too common power of being able to make experiments which will confirm ideas whether they are right or wrong, if these views take his fancy, or if they look like winning horses, *e. g.*, his sulphocyanate experiments. He appears also to corroborate some views brought forward in my earlier books which long since I have found reason to abandon or at least modify very much, *e. g.*, the size of the tongue *due to mastication* and the cause of adenoids, while some points which I have brought forward during the last two or three years are conspicuous by their absence, *e. g.*, the relative permeability of foods by saliva. Had he not relied so implicitly on my earlier views it might have spared him from making some misleading experiments and inferences which are now rather out of date.

His book seems to have other more serious faults. Sir Ray Lancaster, surely a great authority, contends that one of the greatest aids to progress in scientific research would be the total abandonment of the view that acquired characters are transmitted. This I believe to be true and, as repeatedly indicated, my whole work was stimulated and guided by having abandoned such views. If, then, we discount Dr. Pickerill's most misleading views on this fundamental question of heredity, if we discount what appears to be a flagrant attempt to pervert the facts of dental history, if we discount his confirmation of physiological facts known to all, and used by both Professor Gies and me to explain the rationale of oral hygiene, etc., we find but little remains of original merit in his book. I am particularly glad, however, that Dr. Pickerill has confirmed my views on the existence, the nature and the function of the "afterflow" of saliva, for the data which I brought forward in support of my ideas were not so full as they should have been, more especially considering the importance I claimed for the afterflow. At the same time his service in this respect would have been greater had he not "confirmed" views which were not accurate, and had his work been free from the suspicion of bias. I do not know how far his methods may have been employed or suggested by others, though not acknowledged, but where probably least suspected we may find his methods to have been previously used by others for a similar purpose, *e. g.*, the rubbing of the surface of the teeth with a more or less adhesive powder to indicate where food was liable to lodge unduly.

For these and other reasons I value the work of Professor Gies and his collaborators far more highly than I do his. I can rely on the truth of the facts which they bring out in their experimental work.

Although stimulated by and resulting from my theory, no one should withhold credit from Dr. Pickerill for his experimental corroborations, to credit him with originating the views which he so closely follows would be to show ignorance of dental literature for the last ten years if it did not indicate anything more discreditable. I am, dear sir,

Yours faithfully,

J. Sim Wallace.

NOTES ON PRACTICE

Compiled by William D. Tracy, D.D.S., New York City

Technique of Making Gold Inlays by Direct Method.—The patient is allowed to hold a mouthful of water as warm as can be tolerated for a few minutes before wax in inserted in cavity. Cool water, but not ice water, is used in the mouth to harden the wax just before removal. After removal it is placed for about five minutes in a fifty per cent. solution of nitric acid, then washed with cool water, and finally washed with a solution of liquid soap. Mix the investment with tepid water about 80 degrees F., instead of cold water.

Do not chill the wax model just before investing, rather dip it for a few moments in water 80 degrees F. If Taggart's investment is used, mix for one minute, jar and rotate bowl for two minutes. Twenty minutes after investing begin to heat and burn out the wax, which should not require more than twenty minutes. Let the crucible cool for fifteen minutes, then proceed to cast, using an alloy of two parts of pure gold and one part of twenty-two karat solder.

Inlays cast on this schedule as to time are more perfect in every respect than is usual when greater periods of time have been allowed to lapse.—Dr. J. E. Nyman *in Report of Clinics, Published by Illinois State Dental Society.*

Cavity Preparation for Amalgam Work should be similar to that for inlays. The margins should be clean cut, polished and well extended, and in their preparation the mounted carborundum stones will be found invaluable. In deep cavities build up with cement to obtain typical preparation with flat seat. Little or no undercut is necessary if the first layer of amalgam is cemented in, as is the writer's invariable custom. The zinc cements are used, except in a few cases, where the oxy-phosphate of copper seems advisable.—W. R. Pond, *Items of Interest.*

Infiltration Anesthesia has but a limited field, which is due to its short duration, the need of repeated punctures of the mucous membrane and to the fact that it cannot be used

in infected areas. The best results are obtained with conducive anesthesia.

The advantages of conducive anesthesia are: (1) its long duration; (2) with one or two injections, and less of the anesthetic, large areas are anesthetized; (3) the infiltration of infected areas can be avoided; (4) the procedure is even less painful, because the solution is injected without pressure, and into loose tissues.—THEODOR BLUM *in Items of Interest.*

Zones of Safety in Cavity Formation.—The thing of greatest importance in cavity preparation is to include within the cavity outline the field of liability, extending the margins to an area of cleanliness, thereby placing them in an area of immunity. Having done this, the ideal position for the cavity outline will have been reached as far as extension for prevention is involved.—*From a Report of Clinics, Illinois State Dental Society.*

Removal of Facings Without Injury.—In the case of replaceable teeth, their removal from the supporting structure *after* they have been cemented to place may frequently be desirable, or become necessary for various reasons. Whenever this is indicated, any of the forms now used may be easily removed by placing the piece in nitric acid, and allowing it to remain for several hours, or until the cement has been dissolved. This will permit of their ready detachment, without injury to either porcelain or gold.—HART J. GOSLEE, *Items of Interest.*

Metal Mandibular Splint.—In the fracture of the body of the mandible with several sound teeth on each side of the break, and without much displacement, undoubtedly the best method of fixation is by means of the metal mandibular splint, which permits of opening and closing the jaws for cleansing, mastication, etc. For all other fractures, *i. e.*, of the body of the bone where teeth are poor and few in number, where there is much displacement of fragments, in multiple fractures and in fractures posterior to the teeth, where the posterior fragment cannot be fixed, absolute accuracy in adjustment can be insured only by means of the metal mandibulo-maxillary splint with the closed bite.—R. J. IVY, *Dental Cosmos.*

Early Orthodontia.—It is a recognized fact that rhinology to-day looks to dentistry for aid in establishing normal breathing. By stimulating the growth of the bones and widening the upper arch, the floor of the nose is enlarged. The meati are enlarged, septal curvatures are modified and restored function encourages growth of the nose. We who are custodians of the mouth are also responsible for the condition of the nose. It is self-evident, therefore, that we should guard against the formation of spurs, enlarged turbinates and pathological conditions, by bringing about normal occlusion as soon as is feasible, instead of waiting until the full complement of the teeth erupt.—J. A. CAMERON HOGGAN, *Dental Cosmos.*

"Clean" Teeth.—We have in times past made the statement to our patients that "clean teeth will not decay." And this is perfectly true, but the only way that we can have an absolutely clean tooth is to remove it from the mouth, and keep it in a clean place. Cleanliness of the teeth in the mouth is but a relative term, and, even though a tooth be polished ever so thoroughly, it is immediately covered and bathed in an infection and acid-producing fluid which may begin at once the early stages of caries. Especially is this true in some mouths, where we see that the greatest care by the patient and the operator is not able to prevent the occurrence of caries.—RUSSELL W. BUNTING, *Dental Cosmos.*

Possible Danger from Ammonium Fluorid.—An extracted tooth immersed in a solution of ammonium fluorid, taken from bottles labeled as such, and sold to the dental profession, will be completely denuded of enamel in from four to eight hours. The cementing substance seems to be dissolved out, setting the enamel rods free, a drop of the milky fluid taken from the test tube and placed under the microscope showing the loosened enamel rods. If the ammonium fluorid be removed occasionally layer after layer of the whole tooth can be washed away from time to time, until the entire tooth will have been dissipated.

The chemical difference in the enamel of an extracted tooth and one in the mouth being about nil, it seems reasonable to suppose that a chemical so destructive would be dangerous to apply to teeth, since any dissolution of the cementing substance of the

enamel rods, be it ever so superficial, would create a nidus for the beginning of caries, by opening the structure advantageously for attachment of the plaque.—*Editorial, Nebraska Dental Journal.*

Responsibility in Dental Malpractice.—At present, the possibility that arthritis and other diseases may have their origin in septic areas about the roots of filled teeth is scarcely more than a probable hypothesis. But it is not impossible that within a few years cold science will have changed this from a theory to a proven fact. If so, then, in a case of arthritis traced by a physician directly to an improperly filled root canal, there is but little doubt that the dentist who imperfectly filled the root, thus initiating the septic lesion, may be mulcted in heavy damages as a malpractitioner.—R. OTTOLENGUI, *Editorial, Items of Interest.*

Bacterial Plaques.—The existence of the gelatinoid plaque has been thoroughly demonstrated by Black, Williams and Miller. There is no doubt as to its presence, nor that it is a factor of great importance affecting localization of caries. Increased activity and greater virulence of the micro-organism protected by the plaque is found in almost all cases, and it would seem that in the control of such plaques might be found the correction of the disease.—EDGAR D. COOLIDGE, *Dental Cosmos.*

The Conservation of Tooth Roots is as important as the filling of more or less defective crowns, first, for esthetic and physiologic reasons, because the absorption of the alveolar process subsequent to the extraction of roots impairs facial expression, and contributes to loosening and tipping of the remaining teeth. Especially in young persons, not only the roots of anterior teeth must be preserved whenever possible, but also those of the posterior teeth in order to preserve the fullness of the cheeks.

Even if the roots are not to be used for crowns or bridge abutments, correctly treated and preserved roots afford a much better basis for prosthetic pieces than when absorption of the alveolar ridge has taken place.—A. JOACHIM, *Journal Dent. Belge.*

Shaping Proximal Fillings.—Perhaps of all cases it is the proximal cavity that is most sinned against. We have but to look into the mouths of our patients to see that someone—always

the "other fellow"—has neglected to get sufficient separation to restore the proximal space at the gingival margins. There was then no room to produce a normal contact which would allow the food to traverse the mesial and distal surfaces of the adjacent teeth, and cleanse them. And then, we see that when he has inserted his filling he has made the occlusal surface, in the molars and bicuspids, just as flat as possible. He may have spent some considerable time in perfecting a high polish, but his result has been a surface which is of little use for grinding, and can only crush the food or hold it while the cusp of the opposing tooth punches holes in it. The operator has forgotten that all-important little marginal ridge which the Great Creator has put on the mesial and distal borders of those teeth to make them effective in mastication.—RUSSELL W. BUNTING, *Dental Cosmos.*

The Manipulation of Amalgam in the palm of the hand is not only unsanitary, as it entails introduction of perspiration, bacteria and epidermal cells into the mixture, but also interferes with the perfect working quality of the amalgam.—R. H. REITHMULLER, *Dental Cosmos.*

Oleate of Cocaine for Desensitizing Hypersensitive Dentin.—The importance of preserving the final permanent molar is recognized by all. Frequently, there are cases present in the mouths of young children where the first permanent molar is badly decayed, with the pulp fortunately still vital. How to treat and protect this pulp is often a very difficult problem. If the cavity is such that the remedy can be sealed in, I frequently use the official oleate of cocaine. This is a rather new preparation, having been introduced for the first time in the last edition of the United States Pharmacopeia. The cavity should be kept dry, preferably by use of the rubber dam, when all dentin which is to be obtunded should be covered with the remedy. Dry cotton is then placed over it, and the cavity sealed with a temporary cement, to prevent pressure. In case the oleate of cocaine cannot be obtained, I suggest the following formula, which will act equally as well: 2 grains each of the alkaloidal cocaine and thymol added to ½ drm. sterilized liquid petroleum. This formula has the added advantage of being a disinfectant as well as an analgesic.—E. W. ELLIOT, *Dental Review.*

Silicate Cements.—The objection to much of the trade nomenclature of the silicate cements is that the laity may be misled by the names, and imagine that they are receiving true porcelain fillings. I have spent much time in explaining to persons who have come to me complaining that their porcelain fillings, put in by some of my brother dentists, had loosened or discolored, that those fillings were not true porcelain fillings, but only cement of a semi-permanent nature. This misleading of the public regarding silicate cements has been the subject of special mention in annual reports of committees, and in the addresses of presidents of our dental societies. Thus, Dr. H. W. Le Febre, in his presidential address before the Colorado Dental Society in June, 1913, says: " A thing to be regretted in this connection is that there is a tendency among some dentists to mislead the public by giving them to understand that this is a permanent porcelain similar to a baked porcelain inlay. This is decidedly wrong, because of the comparatively short time that the silicate cements have been used, and if they do not prove to be what we hope, it will cause a just reflection upon our veracity."

In the report of the Committee on Practice of the New York State Dental Society for 1911, we find this: " The use of this material is causing much misunderstanding among our patients, as it is frequently used as, and called ' porcelain ' filling, producing confusion with the porcelain inlay. Silicate cement has its place, also its name, and, to be ethical, let us not make the public believe that they are getting porcelain when silicate cement is used."—C. C. Voelker, *Dominion Dental Journal.*

Alundum Polishing Powder.—Silica or chalk used for polishing teeth (after cleaning them with pumice) leaves a comparatively dull surface compared to that which levigated alundum imparts.

The use of this material for polishing purposes was discovered and given to the dental profession by the writer. Alundum is a fused oxide of alumina, which occurs in nature as the mineral corundum, an abrasive that our grinding wheels were formerly made of. The sapphire, the Oriental topaz, amethyst and emerald are composed of this material in well-crystallized forms. Colored by various metallic oxides alun-

dum is an abrasive made by an electro chemical process; as prepared for polishing teeth it is an amorphous powder. All powders that polish should be amorphous, that is formless or of irregular shape. If an abrasive is of regular or crystalline structure it possesses cutting or grinding qualities, as emery for instance. Such material is excellent for cutting down and smoothing metals, but should not be used for polishing teeth. This also is true of carborundum, adamite, crystolon, silica and cuttle fish (which latter material is always finely ground silica, notwithstanding its label).

This amorphous powder is obtained by crushing and grinding large fused blocks of alundum under water, and is the finely ground, collodial alundum, that is found floating on the top of the grinding trough. The material is collected, washed, and all traces of iron (which may have entered from the jaws of the crusher) removed with an electro magnet.

A small amount of the alundum is placed in a dish and moistened, this paste is then rubbed on the teeth, coating two or three at one time. A napkin should be used to keep the teeth dry, while a very soft polishing brush should be used, run at high speed, taking care not to hold the brush in contact with the tooth long enough to heat it unduly. This material is prepared by the Norton Company, of Worcester, Mass., and should be free from iron or any metallic oxides. It should float, to be suitable for dental use. In larger form alundum is the hardest grinding stone known, and will easily cut carborundum. At the present time the writer is trying small dental engine stones for preparing cavities made of this material, and believes with a feldspar bonding material this stone should cut as well wet as it does dry.—FREDERICK H. NIES, D.D.S.

CURRENT DENTAL LITERATURE

COMPILED BY C. WILLIAM RUBSAM, D.D.S.

THE EARLY EVIDENCES OF FUTURE MALOCCLUSION AND THE ADVANTAGES OF IMMEDIATE TREATMENT. By Milton Tate Watson, D.D.S.—*Dental Register.*

The importance of early diagnosis has been emphasized in this paper, showing that treatment undertaken early enough can overcome the major part of the deformity and check its evil influences. Treatment begun at four, five, or six years of age, requires less physical force to produce the necessary changes, and means less nervous strain to the child, in that the impaction of developing teeth is avoided. The most important consequence of delayed diagnosis and treatment is abnormal nasal respiration. Short, narrow arches mean less space for the tongue than it needs. Being forced backward into the throat, the tongue pushes the soft palate upward and backward against the post-pharyngeal wall, preventing the subject breathing through the nose, no matter how much nasal space there may be. Early enlargement of the dental arches, when necessary, prevents a whole cycle of evil influences, which would take place if this lack of development were allowed to continue for any considerable length of time.

The principal advantages gained by early treatment in the order of their importance might be named as follows: 1st. A marked aid in developing the normal breathing capacity, including the far reaching influence this has upon the general health of the child. 2nd. Sufficient space can usually be provided for the eruption of the permanent teeth, though providing this space will not, of course, prevent teeth from erupting in a rotated position if they have started to calcify in that way. 3rd. At this early age children do not object in the least to being "decorated" with regulating appliances. 4th. The amount of physical force required to stimulate development of the jaws in little four, five or six year old patients is so slight that it is actually a source of almost no discomfort at all, except just while the child is becoming accustomed to the appliances when they

are first adjusted. It is literally true that with these little patients we simply stimulate and control the direction of growth, while with older patients, especially those past twelve years of age, the force required is violent—by comparison only, of course. 5th. There can be no question also of the advantage of doing the major part of an orthodontic operation with appliances attached to the temporary teeth, for it is idle to deny the fact that teeth are sometimes injured because of the wearing of regulating appliances. This injury is, however, in nearly all cases, due wholly to the lack of proper home care of the teeth, for, of course, if foodstuffs are allowed to accumulate about the appliances and to become fermented, the result is an acid condition which will decalcify, superficially at least, the tooth surface with which it is allowed to come in contact. This, naturally, should always be guarded against by properly instructing the patient or nurse regarding the care of the teeth. If in spite of this care injury should result, it is of comparatively little importance as it involves only the temporary teeth.

Now, how shall we know at four or five years of age that a child's jaws are not going to develop properly? The simplest cases, from a diagnostic standpoint, at the early age of four or five years, are of course those in which the lower jaw is in either mesial or distal relation to the upper. A condition of this sort really involves such a conspicuous facial deformity that even the parents are aware of its existence, and need only to be told that such a condition nearly always grows worse instead of better. A type of case which is much more common, and which all parents and, as yet, the majority of dentists look upon as perfectly normal, is that in which the jaw has developed sufficiently to just provide the necessary space for the temporary teeth, but never develops any more. If the child's jaws were really developing normally, at about four years of age spaces should begin to appear between all the front teeth above and below; at about five years of age these spaces should be well marked, and if they are not, then you may feel very certain that the permanent teeth will be irregular. Another confusing type is one in which an apparently satisfactory width is developing, but where the mesio-distal relation of the dental arches

is slightly abnormal, possibly an end to end occlusion of the temporary molars. This type of case will progress to the entire satisfaction of the parents until the permanent cuspids begin to erupt, and then, of course, there is little or no room for them, or if they erupt in advance of the bicuspids then at least one of these teeth will be forced to erupt in a lingual or buccal position. Dr. Watson states that these rather simple and easily understood facts can be accepted as very safe guides in determining whether or not these little children require attention.

Relation Between Carious Teeth and Malnutrition. By Charles D. Carter, D.M.D.—*New York State Journal of Medicine, 1913.*

The essayist has divided his article into two parts, one adhering strictly to the title subject, and the other, as a natural corollary, is devoted to the relationship of diseased teeth to other local affections. When the efficiency of the masticating power of the teeth is lowered by carious processes, the teeth become contributory factors in the production of a general malnutrition. Food not properly masticated arrives in the stomach in a condition which prevents thorough digestion by the gastric fluids, and either causes gastritis or passes into the small intestines, inviting putrefaction and constipation, with the long chain of illnesses which may be traced to the latter source. Decayed teeth are the incubators of germs, and are places for toxins and ptomaines to be manufactured.

He states the daily secretion of saliva as forty-eight ounces, and claims that no antiseptic properties of it have been discovered.

Admitting that the gastric juice will destroy most of the micro-organisms taken with the food, Dr. Carter points out that during the periods of rest, when no hydrochloric acid is present in the stomach, the constant admission of impregnated saliva will produce infection in the mucous lining of that organ, and will impair the integrity of the secretory glands. Those micro-organisms which find their way into the small intestine are capable of being absorbed into the blood stream, and carry on their devastation in the form of kidney, liver and pancreatic disturbances. In consequence of these latter affections, perfectly

digestible food fails to be completely assimilated. This results in the condition known as malnutrition. This condition is not the product of days or weeks of faulty mouth hygiene, but is the sum total of months and years of neglect. The school-child with pus laden saliva from abscessing, deciduous teeth and carious permanent teeth is harboring a condition that decreases mental, moral and physical status.

The remainder of the article is devoted to the associated local disorders, and comes as a natural corollary to the discussion of the effects upon the nutrition of the entire body of toxin environed dentures.

Otitis media may exhibit itself as toothache, or, on the other hand, pain in the middle ear may be a reflex of odontalgia. Nine out of ten cases of neuralgia are claimed by Dr. Carter to be from diseased teeth.

THE TEETH IN ARTHRITIS. By J. Ekchian, Dental Surgeon of Paris Faculty of Medicine.—*Gazette Medicale de Paris.*

As uric acid and urates in excess are characteristic in arthritics, puron-forming substances must be partaken of sparingly. If all efforts fail to diminish the production of uric compounds, the elimination must be increased. Arthritism must be combated, as it predisposes toward gout, rheumatism, biliary, and uric acid lithiasis, asthma, diabetes, and of special interest to us, expulsive gingivitis, better known to us as pyorrhea.

The author traces the course of this disease thus: "The loosened tooth now becomes annoying, the acute crises become more frequent, the previous indolent condition is replaced by a sensation of weight accompanied by sharp shooting pain, and considerable pus issues from the alveolus upon slight pressure. The last fibrous adhesions, which still hold the tooth in the alveolus, become hypertrophied and converted into reddish fungosities, which add their inflammatory exudate to the pus that already bathes the alveolus. The fungosities naturally crowd out the tooth, which, loose in the gum, is very painful when pressed upon. The tooth, exuding further and further, finally drops out spontaneously, or as the result of violence. The disease thus terminates with the expulsion of the diseased tooth,

the gum resumes its normal condition, heals rapidly without leaving any trace of the dental lesion."

He associates this condition with diabetes, gouty and rheumatic arthritics. Pyorrhea seems to affect arthritics, in that they are subject to joint affections, and the tooth in its socket, being an articulation by gomphosis of bone and root, does not escape the general involvement of all the joints. There is no valid reason for the escape of the tooth articulations, and these often prove the first joints to be involved. Rheumatism of the gums is often a forerunner of general rheumatism. Frequency of pyorrhea in arthritics is attributed to the poor nourishment of the tissues, due to defective circulation. The alveolar ligaments are affected with a congestive swelling, favoring infection and necrosis.

The saliva of arthritis is alkaline and contains calcium phosphate and calcium carbonate in excess, the latter being insoluble in this medium. This results in their deposit as tartar formations, with resultant loss of gums and ready entry of infection. Suppuration takes place easily, and extends progressively from the gingivitis to the apical region.

The treatment recommended is the elimination of the uric products, followed by diminishing in alkalinity of the saliva, lessening of the tartar formation, and consequent lessening of the liability of infection and pyorrhea. In other words, urea in excess produces masked alkalinity of saliva and calcium phosphate and calcium carbonate in excess, tartar formation, recession of the gums, infection, and pus formation.

Urodonal, an effervescent granulate, is advocated in daily doses, being a standard therapeutic agent on the Continent. It is more active than lithia, which is usually employed.

Diet should be carefully attended to as follows: No animal viscera, *i. e.*, liver, kidney, thymus (sweetbreads); no meat juices, no fish; can take bread, milk, eggs, Italian pastes, potatoes, fruits. Among vegetables, no spinach, peas, lentils, beans, mushrooms. No tea nor coffee is permitted, as caffeine is a ready formed puron, as is theobromine in cocoa.

CURRENT NEWS

Items of professional news, of general interest, will be welcomed by the Associate Editor at 51 West Forty-seventh Street, New York City.

An idea of the cosmopolitan patronage of the clinics under the supervision of the Department of Child Hygiene of New York City may be obtained by glancing at the following table of nationalities, compiled regarding the clinic at 124 Lawrence Street, Brooklyn:

Nationalities	No.	Nationalities	No.
American	392	Nova Scotian	1
Austrian	13	German	48
Cuban	1	Irish	183
French	2	Scotch	14
Russian	69	Swedish	19
Italian	353	Norwegian	13
Hungarian	3	English	22
Roumanian	2	Canadian	8
Polish	13	Spanish	4
Dutch	1	Danish	8
Syrian	10	Unknown	387

* * *

In the "Daily Consular and Trade Reports," published March 4, 1914, the U. S. Consul at Basel, Switzerland, writes as follows:

"Only within the last few years have the Swiss people generally become interested in the preservation of the teeth. This is true especially among the middle and poorer classes. It is generally accepted that Basel water causes early decay and disintegration of the teeth.

"Conditions had become so bad that in 1912 the city of Basel established a municipal dental clinic, with a chief dentist and six assistants. The school children are taken to this clinic and thorough examinations made of their teeth. . . . If the child's parents are able to pay for all or part of the work, they are compelled to do so; if they are unable to pay, the work is done free of charge."

The following is an extract from a letter written by Mayor Brown of North Adams, Mass., to the City Council, that appeared in the North Adams *Transcript*:

"An item for a dental clinic is omitted from the Board of Health figures. The appropriation of money for such a pur-

pose is something we should not lightly undertake. Like many another reputed advance in the application of medical and surgical benefits to social improvement, the dental clinic has not won anything like unanimous endorsement from those best qualified to judge of its value and practicability. Imperfections in teeth need not be any more dangerous to the individual or society than other imperfections quite as easily remedied, and yet to undertake at public expense all the remedying that might be demanded with logic equal to that which demands a dental clinic, would put a burden upon taxpayers which would amount to nothing less than confiscation of their property."

It is a far cry from Basel, Switzerland, to North Adams, Mass., but it is natural for us to expect the United States to be the leader in the betterment of dental conditions. We would not go so far as to censure Mayor Brown without better understanding the conditions in his city, but we sincerely hope he will look into the matter more thoroughly. The sooner men in authority and of supposed education realize that the dental need is not caused entirely by "imperfections easily remedied," the sooner the cities that are now dodging the issue will give the poor their dental chance.

* * *

The dental situation in China, from the pen of the Consul at Shanghai, is published in the same report referred to above. The Consul writes as follows:

"The success of the Harvard Medical School in Shanghai suggests that education in modern dentistry might be instituted in China on similar lines. Competent dentists are needed in China, as the practice, outside of the treaty ports, is almost entirely in the hands of the natives, and both methods and implements used by them are crude. . . .

"The Chinese practitioners in these ports present a problem. A Chinese youth serves as an assistant to a foreign doctor for a period of years, being furnished with instruments as needed, and makes himself of use in the simplest services. Later he resigns and offers his services as a full-fledged 'American' dentist, there being no restrictions on the practise in Chinese cities or in international settlements. Not only does he practise

himself, but he becomes a teacher in dentistry, and some of these young men have turned out hundreds of so-called dentists, who go to the interior with a pair of forceps and a few steel drills, together with a more important exhibit of teeth, plates, gold work, etc., which is displayed as an advertisement in the shop window. Some of these practitioners can make a cavity, fill the same and purify a canal with more or less success. . . . It would be well if Americans in a position to formulate a plan for the establishment of a well-equipped and well-staffed dental school in China should earnestly consider the idea. The National Dental Association might take it up, or, more feasible, one of the universities with a dental department of its own, might well project 'university extension' to the Orient. If three or four highly trained men could be sent to Shanghai, or some other Chinese city, with their incomes assured, adding to themselves one or two local practitioners, and a dean who speaks the language as a business manager, a start could be made.

". . . A school with the prestige of an American university back of it, and with dignity and efficiency thus assured, would be a factor to strengthen American interests in China, and incidentally the dentists of the country would secure their dental supplies from the United States."

All this is interesting and shows a great need. But China, too, may be ahead of the United States. This "Chinese youth," who "serves as an assistant and makes himself of use in the simplest services," and who later resigns and "offers his services as a full-fledged 'American' dentist," is apparently a sort of Chinese "dental nurse."

BOOK REVIEWS

By C. Franklin McDonald, D.M.D.

Dentai. Diseases and Public Health. By J. Sim Wallace, D.Sc., M.D., L.D.S. Cloth, 3s., net. Published by Dental Record, Alston House, Newman Street, W., London, 1914.

Dr. Wallace has added one more short essay to his list of valuable works, in this present pamphlet of ninety pages.

The preface states the object of this publication to be "to bring home to physiologists and others the importance of a knowledge of the physiology of oral hygiene, a subject which, notwithstanding its overwhelming importance at the present day, is altogether neglected in text books of physiology." He has presented a most interesting, thoughtful and original dissertation upon this subject. That the doctor is very hopeful and optimistic as regards his propaganda may be seen when he says: "When the physiology of oral hygiene is properly taught, dental caries and consequent and concomitant diseases will soon practically cease to exist in all families which are brought up with reasonable care and intelligence."

The book is divided into three sections. The first deals with dental diseases in relation to public health, drawing attention to the great prevalence of dental diseases and the serious consequences, which are gradually being recognized, as following upon and aggravated by unhygienic oral condition. The etiology of dental diseases is considered in a general way, and in this connection the claim of inherent degenerative changes and heredity as conducive to dental caries is said to be unfounded. The prevention of dental disease, Dr. Wallace claims, is to be found in the proper dieting; the selection of foodstuffs which shall not only be nourishing, but of self-cleansing nature. In this connection the essayist feels that the present diet lists and theories are in need of immediate revisal.

The second division considers the physiology of oral hygiene and divides the process of mastication into four parts. The "mechanical," being the consistency of the food relative to a "rubbing and scouring of the gums and teeth"; the "chemico-

physiological," being the stimulation afforded to the flow of saliva in which acidity is a prime consideration; the "hydrodynamical," the forcing of food shreds between the teeth; and lastly, the "saprophytic," in which the author believes the bacterial flora of the mouth to be useful in liquefying and removing the various shreds lodging between the teeth.

The last section deals with children's and dental diseases, and is directed towards stimulating the idea of not only caring for present dental diseases already under way, but of properly educating parents and children in simple laws of oral hygiene, and especially of directing consideration to a proper physiological diet.

Dr. Wallace may be classed by many as overenthusiastic and visionary. His proposition of proper diet being the simple and positive remedy for a deplorable condition may seem the result of overconfidence. However, he has in this short essay given many valuable facts, and has presented to his readers questions which demand serious and immediate thought.

Without hesitation, it must be said, this book should be read, not once but many times, by all. It is a source of inspiration, worthy of a place in every library, and should find its way into the hands of every young practitioner and student.

NOTICES

AMERICAN MEDICAL ASSOCIATION

The annual meeting of the American Medical Association will be held at Atlantic City June 22 to 26, 1914.

PROGRAM FOR THE SECTION OF STOMATOLOGY.

Tuesday, 2 P.M.

1. Chairman's Address, Dr. William C. Fisher, New York.
2. Mesothelial Tumors of the Jaw, Dr. Robert H. Ivy, Philadelphia.
   Discusser, Dr. Robert P. Bay, Baltimore.
3. Cystic Tumors of the Jaw, Dr. Gordon New, Rochester.
4. Differential Diagnosis of Major Mouth Lesions, Dr. Stewart L. McCurdy, Pittsburg.
5. The Methods of Obtaining Dental Service in Hospitals by the Appointment of Interns, Dr. Herbert L. Wheeler, New York.

Wednesday, 2 P.M.

6. What Shall Be the Content for a Course in Oral Surgery in Our Dental Schools? Dr. A. H. Levings, Milwaukee.
   Discussers:
   a. Dr. Geo. V. I. Brown, Milwaukee.
   b. Dr. Thomas Gilmer, Chicago.
   c. Dr. F. B. Moorehead, Chicago.
   d. Dr. M. I. Schamberg, New York City.
   e. Dr. J. A. Pettit, Portland, Ore.
   f. Dr. Vilray P. Blair, St. Louis.
   g. Dr. M. H. Cryer, Philadelphia.
   h. Dr. James G. Sharpe, San Francisco.

Thursday, 9.30 A. M.

7. The Scientific Routine of Tooth Brushing and Mouth Cleaning, Dr. Joseph Head, Philadelphia.
8. Osteoplastic Surgery of the Face, Dr. Wayne W. Babcock, Philadelphia.
9. Fractures of the Inferior Maxilla, Dr. Henry S. Dunning, New York City.
10. Bacteriology of Alveolar Abscess, Dr. Thomas Gilmer, Chicago.
11. Acute Parenchymatous Glossitis, Dr. Virgil Loeb, St. Louis.
12. The Section of Stomatology as a Factor in the Evolution of Dental and Medical Science, Dr. Geo. V. I. Brown, Milwaukee.

Thursday, 2 P.M.

13. Mouth Infection as a Source of Systemic Disease, Dr. Frank Billings, Chicago.

Discussors:

a. Dr. Edward C. Rosenow, Chicago.
b. Dr. Charles H. Mayo, Rochester.
c. Dr. Victor C. Vaughn, Ann Arbor, Mich.
d. Dr. Charles L. Mix, Chicago.
e. Dr. Daniel H. Squire, Buffalo.

e. (The Peridental Membrane as a Source of Infection.)

f. Dr. C. B. Craig, New York.

f (Mouth Infection in Relation to Nervous Affection.)

We are exceptionally fortunate in having on the program of this meeting the gentlemen whose original work has correlated certain systemic diseases with mouth infections.

An effort will be made to harmonize the different methods of teaching Oral Surgery in our dental schools, and to formulate a comprehensive scheme for a uniform course of instruction.

A very attractive program is here offered and those who are interested are cordially invited to be present and take part in the discussions.

EUGENE S. TALBOT, *Secretary.*

UNITED STATES GOVERNMENT WILL HAVE ELABORATE EXHIBITS AT THE PANAMA-PACIFIC INTERNATIONAL EXPOSITION

The United States Government is preparing a series of elaborate exhibits for the Panama-Pacific International Exposition, which will be far more comprehensive than any display ever made by it before, and will present a complete record of the activities of the Government in behalf of the people during the last decade. The exhibits will be distributed among all of the various exhibit palaces, and will show every phase of the Government's activities.

A feature of a sightseeing trip through Washington, D. C., always is a visit to the United States Treasury, where the actual making of paper notes and coin is shown. A reproduction of this part of the Treasury will be brought to San Francisco, and visitors to the exposition will be enabled to witness the actual manufacture of United States coin in one of the exhibit palaces. The machinery that turns out millions of dollars a day will be taken direct from one of the United States mints to the exposition and every detail of the mintage displayed.

Few realize just what the United States Fish Commission is doing for the American people, and the Government is now preparing the construction of an aquarium, and, in connection with it, the hatchery in which the various stages of development from the spawn to the full-sized fish will be shown.

It is the Fish Commission that keeps the streams and lakes stocked with the edible fishes, and by scientific breeding prevents the extinction

of species. The spawn are hatched in numbers, ranging into the billions, yet, despite the remarkable care with which they are handled, only a small percentage of these ever attain maturity. Large cans of the eggs and the hatched fish are transported from the hatcheries to the streams and must be fed with air every few moments. This requires constant care and exceptional knowledge. The visitor to this particular exhibit will be taken through various departments and shown the hatching of the eggs, the means of transportation, and finally the immense aquarium now being constructed.

For many years the privilege of witnessing actual practice with the big disappearing coast defense guns has been greatly limited, and only acquaintance with army men or influence in Washington could gain the desired permission.

The Government now has consented to permit the visitors to the exposition to have free access to forts adjoining the exposition grounds.

Daily practice on the big guns with subcaliber charges will be held, and weekly target practice with full charges. Each time one of these guns is fired with a full charge, the cost to the Government amounts to several hundred dollars. In addition to this unusual feature the several regiments of soldiers stationed at the Presidio, the largest army post of the West, will maneuver and hold daily drills and exercises and may even compete with detachments of troops from foreign nations attending the international military tournament.

In the Palace of Transportation a postal car will be shown in its entirety, with the postal clerks actually operating a railway mail car. There will also be on the grounds a small post office where letters may be mailed. Every detail of the operation of checking, handling, and transmitting mail may be seen here.

On the sea-front of the exposition site there will be maintained and operated a United States Government Life Saving station, fully equipped, where exhibition drills will be held daily.

The Navy Department's exhibit will be of exceptional interest. The actual work done on battleships will be displayed and explained in detail by the officers in charge, and the education of the enlisted men will be shown.

The Bureau of Standards is one of the least known departments of the Government, yet its work is, without question, highly important. It is this department that fixes the standards of weights and measures, and millions of dollars are expended to prevent the slightest deviation from the fixed standard. The bar, representing one foot in length, is composed of two metals joined together in a most ingenious manner, and the extremes of temperature will not cause this standard to expand or contract one-millionth part of one inch.

A special laboratory is being constructed by the heads of the department, and the various scientific aids requisite to the proper maintenance of the standards will be shown.

Advisory committees will have been appointed by the Bureau of Mines, and the Geological Survey and their exhibits will be intensely interesting to the technical students as well as the general public.

To avoid the duplication of exhibits by various educational institutions the Government is preparing a unified educational exhibit that will show the progress of the country in education during the last decade.

Special attention will be paid to the Panama Canal, the completion of which the exposition is to celebrate, and a five-hundred foot model of the great ditch will be shown. It is said by Government experts that a person may gain a great deal better idea of the canal by a visit to this exhibit than could be obtained by actually passing through the canal. The system of hygiene practiced in the canal zone will receive special attention in the national public health display. It was the scientific work of Dr. Gorgas that made possible the construction of the Panama Canal.

NATIONAL MOUTH HYGIENE ASSOCIATION

ANNOUNCEMENT.

A series of illustrated lectures on Mouth Hygiene is being prepared by this Association for rental service.

The first lecture of the series, a talk suitable for a mixed adult audience or school pupils, above the age of twelve years (designated as lecture "A") is now ready.

The lecture set (manuscript and 36 lantern slides) will be furnished to members of State dental societies and others who may be considered as competent to present the matter to the public at a rental fee of $1 per use.

For further particulars and application blanks, address

EDWIN N. KENT, D.M.D.,
Director of Extension Lectures,
222 Washington Street,
Brookline, Mass., U. S. A.

XI PSI PHI FRATERNITY NATIONAL ALUMNI ASSOCIATION ANNUAL MEETING

ANNOUNCEMENT.

"Good-fellowship, Not Politics."

Place.—Rochester, N. Y.

Date.—July 6. All functions will be held on this day so as not to conflict with the sessions of the National Dental Association.

Headquarters—Hotel Seneca. Register on arrival in the Xi Psi Phi Parlor on the Mezzanine. An entire floor has been reserved for our members.

Functions.—Annual dinner in the large banquet hall of the hotel at 6 p. m. Members of international respect will do the toasting. Be sure to send your acceptance without further notice to Dr. George C. Lowe, 813 Chamber of Commerce Building, Rochester, N. Y., so that reservation may be made for you. *This is important*—so that the correct number may be provided for.

The Annual Business Session will immediately follow the banquet. Matters of the utmost importance will come up for disposal, and your presence is, therefore, strongly urged.

Membership Committee.—Kindly get in touch with Dr. C. C. Markey, 1436 People's Gas Building, Chicago, Ill.

C. O. SIMPSON, Secretary, St. Louis, Mo.
L. M. WAUGH, President, Buffalo, N. Y.

NEW JERSEY STATE DENTAL SOCIETY

The twin cities by the sea (Ocean Grove and Asbury Park) will again entertain the members and guests of the New Jersey State Dental Society. The forty-fourth annual convention of the Society will be held in the North End Hotel, Ocean Grove, N. J., on July 15, 16, 17, 18, 1914, begininng at 10 A.M., on Wednesday, July the 15th.

The North End Hotel is one of the largest and finest on the Jersey coast and is situated directly on the beach front at the foot of Wesley Lake and within a moment's walk of the Asbury Park Casino and trolley. Connected with the hotel by a bridge over the boardwalk is a large pavilion built over the ocean. The second floor of this pavilion will be devoted exclusively to the exhibits and clinics.

Dr. Walter F. Barry, 220 Essex Avenue, Orange, N. J., is chairman of the Exhibit Committee, and has made an ideal arrangement of space for the exhibits. Dr. Barry will be glad to furnish information regarding the rates and spaces still available.

The clinics will be in charge of Dr. James I. Woolverton, 228 West State Street, Trenton, N. J. Plenty of space will be available, so that crowding will be avoided and every one will have a chance to see the clinics.

The meetings of the Society and the reading of papers will take place in the hotel either in the American dining room or in the picture theatre. This will be announced in the programme, which will be issued about July 1.

At the hotel end of the bridge, a room will be reserved for the officers of the Society as headquarters, and this will be the Executive office and Bureau of Information during the convention.

A cordial invitation to attend is extended to all ethical practitioners.

JOHN C. FORSYTH, Secretary,
430 East State Street, Trenton, N. J.

THE JOURNAL

OF THE

ALLIED DENTAL SOCIETIES

VOL. IX SEPTEMBER, 1914 NO. 3

BIOCHEMICAL STUDIES OF SALIVA AND TEETH

BY WILLIAM J. GIES AND COLLABORATORS.

(*Biochemical Laboratory of Columbia University, at the College of Physicians and Surgeons, New York.*)

CONTENTS.

I. INTRODUCTION.

WILLIAM J. GIES.

During the recent summer session at Columbia University (July 6-August 14), several courses in biological chemistry were conducted in this laboratory. One of these courses, as originally catalogued, was entitled "Research." A course of research in biological chemistry is obviously a course of laboratory in-

struction, both in methods of biochemical inquiry and in the spirit of experimental investigation, as applied directly to, and exemplified in the study of, one or more problems awaiting solution. Such a course, to be of the greatest effectiveness, must be a course of special instruction of advanced students *independently,* rather than in classes.

Of the comparatively large number of men and women who assembled at the College of Physicians and Surgeons for the purpose of taking our summer courses in biological chemistry, several desired, as candidates for the A.M. or Ph.D. degree, to devote all or half their time to research. The cumulative increase in our attention, in this laboratory, to research in dental chemistry; our growing appreciation of the importance of research in this field; and our conviction that the methods of research in dental chemistry are as rigorous, as instructive and as scientifically potential as those of any other branch of biological chemistry, led me to inquire of the students electing "Research," whether they believed that various suggested subjects relating to the chemistry of saliva and teeth would interest them sufficiently to justify our selection of such subjects as a basis for their instruction in research. The replies to this question were enthusiastic in the affirmative. Accordingly, we began at once a series of studies which bore the fruit presented here.

If I am not mistaken, this was the first formal course of *research in dental chemistry* ever offered. It was given on a "pure science, Ph.D., basis" and was equivalent, in academic quality and credit, to any course in Columbia University to which an equal number of hours is devoted. Begun without special preparation or premeditation, conducted with enthusiasm and care, taken in earnest and sustained interest, affording instruction and profitable experience for student and teacher alike, and also yielding scientific results of value in spite of its preliminary and untried nature, the course has opened the writer's eyes to far-reaching possibilities in behalf of dental education and dental science, from a development of such courses of instruction in *research* in dental subjects.

I propose to give special attention to the continuance and development of our course of research in dental chemistry, and

hope to find time to outline the details of an extended course of this kind, to be given here next summer, for publication in an early issue of this JOURNAL.

Ignoring "fads and fancies," and speaking of *facts*—dentistry is a *natural* branch of medicine; and the biological principles of dentistry deserve, and should receive, special attention in formal medical instruction. I have no respect for tradition that traduces truth. The tradition that dentistry is merely tooth-pulling and tooth-filling—"mere carpentry," or "tinkering," or a "barber's job," requiring little skill, less knowledge, and no education—is a tradition that is not only untrue, but unjust; a tradition that must be brought to an end, and speedily, in the interest of more rapid growth of *scientific* dentistry and, through scientific dentistry, in the interest also of more efficient personal and public hygiene. We shall aim to carry forward certain contemplated plans for the development of a strong course of research in dental chemistry in this laboratory, as a matter of academic and scientific justice to the dental profession, small though the influence of such a course may be, and also as an opportunity for active service on our part, as a university, in behalf of dental science.

The names of the students who elected the course of research in dental chemistry and who, by becoming the innocent victims of this academic innovation, helped to write the first page of a new chapter in the history of dental education and science, are given below, with a few details pertaining to the scholastic career of each:

Louise C. Ball (B.A., New York City Normal College, 1905; Hunter College, 1914; candidate for the D.D.S. degree at the College of Dental and Oral Surgery of New York City, 1915; candidate for the Ph.D. degree, Columbia).

Leon Loewe (undergraduate, Cornell University, Ithaca, N. Y.; candidate for the B.A. degree at Cornell in 1915 and M.D. in 1918).

Arnold Messing (B.A., College of the City of New York, 1912; third year medical student, College of Physicians and Surgeons, New York; candidate for the A.M. degree, Columbia).

William A. Perlzweig (B.A., Columbia University, 1913,

A.M., 1914; assistant in biological chemistry, 1913-; candidate for the Ph.D. degree, Columbia).

G. H. Whiteford (B.S., Maryland Agricultural College, 1897; A.M., Columbia, 1912; professor of chemistry, Albright College, Myerstown, Pa., 1911-; candidate for the Ph.D. degree at Columbia.)

The course was given by me in person, from beginning to end; that is to say, we took the course together under my guidance. The experiments were conducted under continuous surveillance and repeated direction. Methods and pitfalls were described intimately and demonstrated in detail. Illogical inferences and inadequate procedures were frankly exposed and pointedly discussed. Repetitions from different points of view, and numerous control observations, guarded against analytic and experimental error. *Principles* were usually established by a division of labor between student and teacher in direct and simultaneous co-operation—often in demonstrations by the teacher.

The problems selected for investigation were such as could probably be solved, in principle at least, within a short time (six weeks), by direct attack with comparatively simple methods, and with ordinary supplies and apparatus. The lack of preliminary preparation for the course (which, as already explained, was not conceived until the day the summer session opened), and the necessity for proceeding at once to the best advantage under the circumstances, made the selection of more comprehensive problems and more complicated means impractical. Problems of wider range will be included in the plans for the future development of this course, and will be mentioned in the proposed announcement regarding it to be published in this JOURNAL, as stated above.

The mucin and sodium mucinate preparations, referred to in the various papers succeeding this introduction, were taken from residues of pure products originally made for researches already described in this JOURNAL.[1] The various chemicals employed for quantitative purposes, such as tri-basic calcium phosphate, were either products of " tested purity " supplied by Eimer and Amend, or " K " products " made in Germany " by Kahlbaum.

The appended descriptions are written as briefly and directly

[1] Lothrop and Gies: *Journal of the Allied Dental Societies*, 1912, vii, p. 409; 1913, viii, p. 291.

as the nature of the described experiments permit. Each consists of three parts: Introduction, methods, results. General deductions pertaining to each research are summarized at the end of the series (page 406).

II. STUDIES PERTAINING TO SALIVA.

A. FACTS RELATING TO REACTION AND TURBIDITY.

1. On the decomposition of sodium bicarbonate, with special reference to the yield of carbon dioxid and the relation of the latter to the determination of the reaction of saliva.

Leon Loewe.

INTRODUCTION. Among the constituents of normal saliva are bicarbonates, such as sodium bicarbonate. It is well known that bicarbonates readily undergo dissociation into the corresponding hydroxids and carbon dioxid, and that carbon dioxid may be freely evolved from such mixtures. Our general knowledge on these points is expressed by Mendeléeff as follows:[2]

"Not only when heated alone, but even on being slightly heated in solution, and also at the ordinary temperature in damp air, sodium bicarbonate ($NaHCO_3$) loses carbonic anhydride and forms the normal salt (Na_2CO_3). . . . At 70 degrees C. a solution of sodium bicarbonate begins to lose carbonic anhydride and, on boiling, the evolution becomes very abundant."

In spite of these well-known chemical facts, certain dentists who have not yet realized the desirability of conducting chemical research with the aid of chemical knowledge, publish seriously such nonsense as the following by Bunting:[3]

"In the latest scheme for salivary analysis suggested by the Scientific Research Committee of the National Dental Association, it was recomended that phenol-phthalein be used as an indicator and titration be made against NaOH to obtain the total acidity. This obviously would include the CO_2 of the saliva, *in which we are not concerned* (!) and which would obscure the real (?) acidity or alkalinity of the sample tested. It has been the custom, when wishing to expel the CO_2 from a sample of

[2] Mendeléeff: Principles of chemistry, 1897, i, p. 526 (translated by Kamensky and Lawson).

[3] Bunting: *Dental Cosmos*, 1914, lvi, p. 287; see also criticism by Gies: *Journal of the Allied Dental Societies*, 1914, ix, p. 295.

saliva, to boil for *a* varying (!) length of time until in the judgment of the individual the fluid is CO_2-free. But we must all admit that the moment we bring saliva to a boil we have no longer normal saliva, but a very different compound (!) which has resulted from the boiling. We know that the proteins, which are so prominent in the saliva, are coagulated and tend to precipitation on boiling. Furthermore, many amino-acids are split off (?) from these proteins, having an alkaline (!) reaction to the reagent. The average saliva is acid to phenol-phthalein when fresh, and if boiled, many of them become neutral or alkaline as the CO_2 escapes; but the longer we boil, the more alkaline it gets, and who shall say at just what point we have entirely discharged our CO_2, and where we begin to form alkaline decomposition products?

"Another method of discharging the CO_2, and one which has been used entirely by the author of this paper during the past year, is that of *passing CO_2-free air through the sample while warming the fluid to not over* 50 *degrees C.* (!) This will discharge all uncombined CO_2 from a saturated solution in from five to ten minutes (?), and although even this low (!) temperature may break up some loosely (?) combined substances, still its effect is probably less than (that of) any other method which would be practicable for our purposes." [4]

Any method of determining "total" acidity of a given specimen of saliva, that would ignore the carbon dioxid removable from it, would not determine "*total* acidity." To say that "we are not concerned" about the carbon dioxid contained in, or removable from, saliva is to speak of reaction without comprehension of its significance. We wonder *where* "it has been the *custom,* when wishing to expel the CO_2 from a sample of saliva, to *boil* (!) for *a* varying (!) length of time until in the judgment of the individual the fluid is CO_2-free." Every chemist would assume that this method would be a mere waste of time, for, under such conditions, salivary bicarbonate would be largely decomposed into carbon dioxid (which would escape) and normal carbonate, with greater alkalinity (which would remain). It is the formation of the latter kind of material, rather than the imaginary "many amino-acids split off (?) from the salivary pro-

[4] There were no italics and no interrogation or exclamation marks in the original.

teins having an alkaline reaction," which explains, in the main, why saliva that is acid, to phenolthalein, "becomes neutral or alkaline" when it is boiled.

Bunting's "method of discharging the CO_2 . . . by *passing CO_2-free air through the sample while warming the fluid to not over* 50 *degrees C.,"* (!) and which he says "has been used entirely by him during the past year," also shows a lack of comprehension of well-known chemical facts that are available in almost every text-book of chemistry. The probability, also, that aeration of saliva with "CO_2-free air" would (1) accelerate the decomposition of contained bicarbonate, (2) eliminate the resultant carbon dioxid, (3) cause *accumulation of soluble normal carbonate,* and (4) increase reaction between normal carbonate and any associated acid phosphate, does not appear to have been thought of or tested by Bunting.

With the foregoing facts in mind, and proceeding on a basis of common chemical knowledge, we have studied some of the influences that might be expected to affect the removal, by aeration, of carbon dioxid from sodium bicarbonate solutions, *under conditions of chemical and physical association similar to those in saliva.*

METHODS. The type of aeration apparatus regularly in use in this laboratory for determinations of ammonia in urine, meat, etc., by the modified Folin process,[5] was employed in each experiment. The air that was drawn through the several solutions involved was conveyed, by suction, at a fair rate of speed through a tightly connected system of containers, successively into a large volume of (1) concentrated sulfuric acid solution (for the removal of alkaline fumes); two or three wash bottles containing (2) 20 per cent. sodium hydroxid solution; and a cylinder containing clear filtered (3) barium hydroxid solution (0.4 per cent.) —each for the removal of acid fumes. After emerging from this preliminary series of *washing* liquids (1-3), the air was entirely free from carbon dioxid, as was shown by the continued clarity of the barium hydroxid solution (3). This air, *free from carbon dioxid,* was then drawn directly from the barium-hydroxid container (3) into a tall narrow cylinder holding the liquid containing (4) sodium bicarbonate, etc., under investigation; thence the

[5] Shulansky and Gies: *Biochemical Bulletin,* 1913, iii, p. 45.

air, carrying any carbon dioxid evolved from the solution or mixture containing sodium bicarbonate (4), was directed into a cylinder holding a measured volume of clear, filtered, (5) barium hydroxid solution (0.4 per cent.) of known volume and alkalinity (expressed in terms of standard *n*/5 sulfuric acid solution against which it had been titrated). Finally, the air freed, in the barium hydroxid solution, from any carbon dioxid that had been evolved in container 4, was carried to the exterior through a bottle of (6) 20 per cent. sodium hydroxid solution, the latter device preventing any possible accession of carbon dioxid by diffusion into 5 from the outer air. Folin absorption tubes were used in containers 2″, 3 and 5.

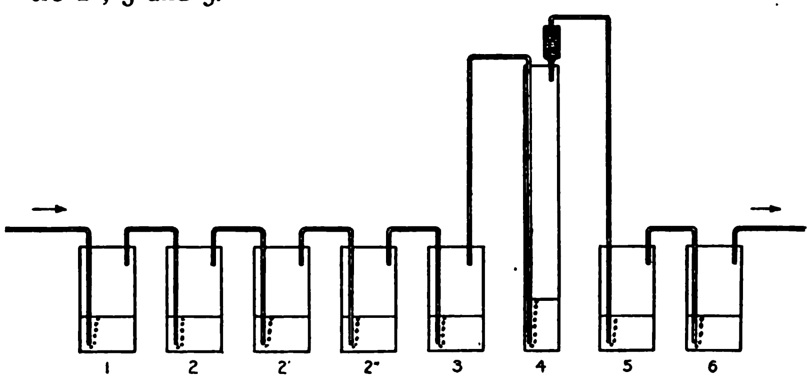

Diagram showing the relationships of the containers in the aeration apparatus

The relations of the containers in the aeration apparatus are indicated by the accompanying diagram.

In order to control perfectly the barium hydroxid solution in container 5, as an indicator of the evolution of carbon dioxid, and also to prevent appreciable accession of carbon dioxid during the preliminary adjustments of the parts of the apparatus, the solution of barium hydroxid (0.4 per cent.) was filtered into a tall, narrow, closed cylinder and thence pipetted directly into containers 3 and 5, which were immediately connected into the aeration system. For the purpose of preventing both gain and loss of carbon dioxid, in container 4, all other parts of the apparatus were first arranged in regular order as described; the sodium bicarbonate solution was then poured into container 4,

the stopper inserted and connections made with container 5. Finally, the liquid to be mixed with the bicarbonate solution was poured down the long tube in closed container 4, and thus directed underneath the bicarbonate solution. Container 4 was then immediately connected with container 3 before any evolved carbon dioxid could possibly escape. Any carbon dioxid in the air above the fluids in containers 3, 4 and 5, that was thus unavoidably allowed to remain in them during the preliminaries, was too slight in amount to affect the results, as the outcome of the control tests amply demonstrated.

The usual precautions to prevent mechanical losses, "sucking back," etc., were observed. The outlet at the top of container 4 consisted of an elongated thistle tube, containing absorbent cotton. This outlet was connected with the tube into container 5 by an L tube through a rubber stopper tightly fitted into the thistle tube (4). This device made it absolutely impossible for spray to pass from container 4 to container 5. The height of the cylinder comprising container 4 (18 inches) also helped to prevent mechanical ejection of liquid from container 4 into container 5. The height of the tube connecting containers 3 and 4 also made it impossible for barium hydroxid to pass into container 4.

After repeated use, the barium hydroxid solution in container 3 occasionally became slightly turbid, showing either (1) that traces of carbon dioxid escaped through the sodium hydroxid solutions in containers 2 (which is very unlikely), or (2) that traces of carbon dioxid, present in container 4 when the aeration process was discontinued, had diffused, or were sucked back into container 3, or (3) that carbon dioxid from the outer air gradually worked its way into container 3, through the connections between it and container 4, *during the periods of preliminary preparation.* This observed turbidity was most noticeable after the aeration of one bicarbonate-*acid* mixture in container 4, a fact that emphasizes the second suggestion of the three immediately preceding. To guard against the third contingency, so far as possible, the tubes connecting with the barium hydroxid solutions (containers 3 and 5) were always kept tightly stoppered during the periods of necessary disconnection of the apparatus. The turbidity in container 3 was never sufficient to suggest the presence in that container of

quantities of carbon dioxid greater than mere traces. *It was never sufficient to imply that carbon dioxid passed through it into container 4,* the essential point in the matter. By repeated renewals of the barium hydroxid solution in container 3 any possible experimental error in this connection was entirely excluded.

Titrations of the barium hydroxid solution in container 5 were compared with control portions obtained simultaneously by filtration from the same supply and kept in similar closed containers. The titrations were made directly in suitable beakers, but the aerated barium hydroxid solutions (5), when turbid, were rapidly filtered in a tall, narrow, closed, filtration apparatus, in order to remove the precipitated barium carbonate, and the measured portion of the filtrate used for titration was pipetted into a beaker without appreciable absorption of carbon dioxid. The experimental procedure in all its details made the "control" solutions perfect standards for determinations (by direct comparisons of the titration values) of the reduction in alkalinity of the barium hydroxid solutions by the precipitation of barium as barium carbonate.

The acid employed for titration purposes was $n/5$ sulfuric acid solution; the indicator was methyl orange.

RESULTS. The results of the quantitative tests are summarized in the accompanying table (1). They show that a large proportion of the carbon dioxid into which sodium bicarbonate dissociates in aqueous solution is removable from such solution by simple aeration. Sodium carbonate (Na_2CO_3) and disodium monohydrogen phosphate (Na_2HPO_4), under the conditions of the comparable experiments, reduced the aeration yield of carbon dioxid, the former more than the latter, whereas *acid* sodium phosphate (NaH_2PO_4) and sulfuric acid increased that yield. These differences were shown not only by the titration figures, but also by the relative masses of the precipitates of barium carbonate in container 5. Egg white, in the large proportions used, markedly interfered with the evolution of carbon dioxid from sodium bicarbonate solution, but sodium mucinate and sodium chlorid had no effect. There was considerable evolution of carbon dioxid from saliva, which originated, quite obviously, from bicarbonate as well as from dissolved, "gaseous," uncombined carbon dioxid. The latter, when present, might have been de-

rived in large part from bicarbonate by interaction between it and acid phosphate, both of which are normally secreted into saliva.

(*General* deductions from the main results of these experiments, and of the experiments described in the remaining papers of the series, are summarized on page 406.)

2. A study of the behavior of several constituents of normal saliva toward phenolthalein and methyl orange.

G. H. Whiteford.

INTRODUCTION. It has long been known that indicators are unequal in value and dissimilar in significance.[6] An indicator that is very useful for one purpose may be useless for another. The

[6] Gies: *Journal of the Allied Dental Societies*, 1914, ix, p. 268.

TABLE 1.—DATA PERTAINING TO THE EVOLUTION OF CARBON DIOXID FROM SOLUTIONS CONTAINING SODIUM BICARBONATE.

Test No.	Contents of container 4		Period of aeration	Alkalinity of barium hydroxid solution (50 c.c.) in container 5, in terms of $n/5$ sulfuric acid solution		Evolved carbon dioxid: acidity expressed as $n/5$ sulfuric acid solution c.c.
	Vol. c.c.	Substance (*added* in 0.2% sol.)	Hours	Before aeration c.c.	After aeration c.c.	
1[1]	100	$NaHCO_3$[2]	3[3]	5.70	3.60	2.10[3]
2	100 40	$NaHCO_3$ (Kerosene)[4]	3	8.00	5.70	2.30
3	100 100	$NaHCO_3$ Na_2CO_3	3	5.15	5.10	0.05
4	100 100	$NaHCO_3$ Na_2CO_3	5	5.13	4.32	0.81
5	100 100	$NaHCO_3$ Na_2CO_3	5	5.70	4.80	0.90
6[1]	100 100	$NaHCO_3$ Na_2HPO_4	2	5.70	4.65	1.05
7[1]	100 100	$NaHCO_3$ NaH_2PO_4	3	6.08	2.72	3.36
8	100 50 50	$NaHCO_3$ Na_2HPO_4 NaH_2PO_4	3	5.70	4.05	1.65

TABLE 1 (*Continued*)

Test No.	Contents of container 4		Period of aeration	Alkalinity of barium hydroxid solution (50 c.c.) in container 5, in terms of $n/5$ sulfuric acid solution		Evolved carbon dioxid: acidity expressed as $n/5$ sulfuric acid solution
	Vol. c.c.	Substance (*added* in 0.2% sol.)	Hours	Before aeration c.c.	After aeration c.c.	c.c.
9	100 100	$NaHCO_3$ NaCl	6	5.70	1.20	4.50
10	100 100	$NaHCO_3$ H_2SO_4	1.5	5.15	1.65	3.50
11	100 100	$NaHCO_3$ H_2SO_4 (0.4%)[5]	3	5.70	0.75	4.95
12	100 5 40	$NaHCO_3$ (Egg white)[5] (Kerosene)	3	5.70	4.95	0.75
13	100 5	$NaHCO_3$ (Egg white) (Kerosene)	3	5.25	3.60	1.65
14	100 50	$NaHCO_3$ Na-Mucinate (Kerosene)	3	5.70	3.00	2.70
15	100 50	$NaHCO_3$ Na-Mucinate (Kerosene)	3	8.00	5.85	2.15
16	50	(Saliva) (Kerosene)	3	5.25	1.05	4.20
17	25	(Saliva) (Kerosene)	3	5.40	4.65	0.75
18	25	(Saliva) (Kerosene)	3	5.40	4.95	0.45

[1] Similar results were shown by the relative masses of barium carbonate precipitate obtained in qualitative observations, for the establishment of principles, before these quantitative experiments were started.

[2] The preparations of sodium bicarbonate were very slightly alkaline to phenolthalein—free from uncombined carbon dioxid. The alkalinity of the solutions was increased by aeration.

[3] The reader should note carefully that the figures in the last column must be compared on the basis of equal periods of aeration.

[4] Kerosene was used to prevent frothing in experiments 12–18. It evidently had no effect on the removal of carbon dioxid (1–2).

[5] Parentheses indicate independence of the percentage value expressed in the column heading.

selection of indicators suitable for the determination of the actual or the potential reaction of saliva, or both, requires special knowledge of the qualities of saliva and of indicators as well.

Among the constituents of saliva are bicarbonates, phosphates, and proteins. These substances individually are neutral, acid or alkalin to a given indicator; collectively they appear to react discordantly with certain indicators, and also with each other, in such a way and to such a degree as to render titration values for acidity and alkalinity of saliva, as obtained with many indicators, uncertain and meaningless, *e.g.*, litmus. On the other hand, in spite of these discordant combination tendencies, some indicators appear to reveal quite fully and accurately a definite feature of salivary reaction, *e.g.*, methyl orange as an indicator of total *titratable* alkalinity.

TABLE 2.—DATA PERTAINING TO THE REACTION OF AQUEOUS SOLUTIONS CONTAINING Na_2HPO_4, NaH_2PO_4, $NaHCO_3$, OR ALL OF THESE SUBSTANCES, AS INDICATED BY PHENOLTHALEIN AND METHYL ORANGE.

Test No.	Solutions				Titration values:[1] $n/5$ H_2SO_4 or NaOH solution					
					Phenolthalein			Methyl orange		
	Na_2HPO_4 (0.2%)	NaH_2PO_4 (0.2%)	$NaHCO_3$ (0.2%)	H_2O	Found	Calculated	Difference	Found	Calculated	Difference
	c.c.	c.c.	c.c.	c.c.	c.c.	c.c.	c.c.	c.c.	c.c.	c.c.
Group I: With phenolthalein and methyl orange										
A- 1	30	..	..	..	0.05	..	..	1.15	..	..
2	..	30	..	..	*2.05*	..	..	0.05	..	..
3	..	..	30	..	0.15	..	..	3.80	..	..
B- 4	20	..	..	10	0.05	0	0	0.80	0.77	0.03 +
5	20	..	10	..	0.10	0.10	0	2.00	2.04	0.04 −
6	20	10	..	..	*0.70*	*0.68*	0.02 +	0.80	0.77	0.03 +
C- 7	..	20	..	10	*1.35*	*1.37*	0.02 −	0.05	0	0
8	..	20	10	..	*1.13*	*1.32*	0.19 −	1.30	1.27	0.03 +
9	10	20	..	..	*1.33*	*1.37*	0.04 −	0.40	0.38	0.02 +
D-10	..	..	20	10	0.10	0.10	0	2.55	2.54	0.01 +
11	..	10	20	..	*0.45*	*0.58*	0.13 −	2.55	2.54	0.01 +
12	..	10	20	..	*0.45*	*0.58*	0.13 −	..	..	..
13	10	..	20	..	0.10	0.10	0	2.90	2.92	0.02 −
E-14	10	10	10	..	*0.55*	*0.63*	0.08 −	1.70	1.65	0.05 +
15	10	10	10	..	*0.55*	*0.63*	0.08 −	..	..	..

TABLE 2. (*Continued*)

Test No.	Solutions.				Titration values:[1] $n/5$ H_2SO_4 or NaOH solution					
					Phenolthalein			Methyl orange		
	Na_2HPO_4 (0.2%)	NaH_2PO_4 (0.2%)	$NaHCO_3$ (0.2%)	H_2O	Found	Calculated	Difference	Found	Calculated	Difference
	c.c.	c.c.	c.c.	c.c.	c.c.	c.c.	c.c.	c.c.	c.c.	c.c.
					Group II: With phenolthalein					
F–16	..	..	30	..	0.20	..	..	New solution		Cf. 3
17	..	30	60	..	*1.35*	*1.65*	0.30 –	Cf. 11		
18	30	30	30	..	*1.60*	*1.85*	0.25 –	Cf. 14 and 15		
G–19	10	10	10	..	*0.55*	*Titrated at once after preparation*				
20	10	10	10	..	*0.50*	" 20 min. " "				
21	10	10	10	..	*0.40*	" 50 " " "				
22	10	10	10	..	*0.35*	" 100 " " "				
23	10	10	10	..	*0.30*	" 2.5 hr. " "				
24	10	10	10	..	0.05(!)	" 20 " " "				
H–25	20	20	..	..	*1.30*	" at once " "				
26	20	20	..	..	*1.35*	" 30 min. " "				
27	20	20	..	..	*1.30*	" 60 " " "				
I–28[2]	20	20[2]	..	..	*1.40*	" at once " "				
29	20	20[2]	..	..	*1.35*	" 22 hr. " "				

[1] The amounts of NaOH solution, as distinguished from the volumes of H_2SO_4 solution, are indicated by figures in italics.

All readings of "0.05 c.c." indicate that 1 drop of the corresponding $n/5$ standard solution was sufficient to provide an *excess* of that solution in the specific titration referred to; that is to say, the fluid to which the acid or alkali had been added was practically neutral to begin with, or was more nearly so before the drop of standard acid or alkali solution had been added than afterward.

The "calculated" results (4–14) represent the *theoretical* values for the constituent volumes, as derived from the corresponding totals in tests 1–3. Thus, the "calculated" figure for test 11, under phenolthalein, is 2/3 of 0.15, *i. e.*, 0.1 c.c. of acid, and 1/3 of 2.05, *i. e.*, 0.68 c.c. of alkali (0.68 – 0.1 = *0.58*). Readings of 0.05 c.c. are regarded as 0 in the calculations. Calculated values of 0.05 c.c. or less obviously represent nothing tangible.

The titration figures for each test represent the averages of closely agreeing duplicate determinations—in most cases the duplicates were identical.

[2] The NaH_2PO_4 solution used in tests 28 and 29 was a new one.

The selection of an indicator for the accurate titration of salivary reaction must depend upon the nature of the particular chemical object in view, and also upon the qualities of indicators and of saliva, *i.e., upon the behavior of indicators toward the salivary constituents individually and collectively*. The latter consideration has been given very little *experimental* attention.

As a *first step* in a thorough study of the behavior of indicators toward the constituents of saliva, separately and in group,

TABLE 3.—DATA PERTAINING TO THE REACTION OF AQUEOUS SOLUTIONS OF SODIUM MUCINATE (ALONE AND CONTAINING Na_2HPO_4, NaH_2PO_4, AND $NaHCO_3$), AS INDICATED BY PHENOLTHALEIN AND METHYL ORANGE.[1]

Test No.	Solutions[2]					Titration values[3]		
	Na_2HPO_4 (0.2%)	NaH_2PO_4 (0.2%)	$NaHCO_3$ (0.2%)	H_2O	Sodium mucinate	Elapsed time between preparation of the solution and its titration	Phenolthalein	
							$n/10$ NaOH	$n/5$ H_2SO_4
	c.c.	c.c.	c.c.	c.c.	mg.		c.c.	c.c.
A– 1	10	10	10	..	60	20 min.	0.30	..
2	..	..	..	30	60	20 "	0.05	..
B– 3	10	10	10	..	60	43 min.	0.15	..
4	..	..	..	30	60	30 "	0.15	..
5	10	10	10	..	60	1 hr., 45 min.	..	0.05
6	..	..	..	30	60	1 " 35 "	0.05	..
7	10	10	10	..	60	2 " 8 "	..	0.05
8	..	..	..	30	60	2 " 2 "	0.05	..
9	10	10	10	..	60	2 " 23 "	..	0.05
10	..	..	..	30	60	2 " 17 "	0.05	..
11	10	10	10	..	60	2 " 38 "	..	0.05
12	..	..	..	30	60	2 " 30 "	0.05	..
13	10	10	10	..	60	3 " 5 "	..	0.05
14	..	..	..	30	60	2 " 50 "	0.05	..
C–15	10	10	10	..	60	10 "	0.80	..
16	10	10	10	..	60	20 "	0.60	..
D–17	..	..	..	30	60	10 "	0.05	..
18	..	..	..	30	60	20 "	0.05	..
E–19	..	..	..	30	60	40 "	0.05	..
20	..	..	..	60	60	40 "	0.10	..
21	..	..	..	90	60	40 "	0.15	..
22	..	..	..	120	60	40 "	0.25	..
F–23	..	..	..	30	..	40 "	0.05	..
24	..	..	..	60	..	40 "	0.10	..
25	..	..	..	90	..	40 "	0.10	..
26	..	..	..	120	..	40 "	0.20	..

With methyl orange as the indicator, the following data were obtained (see Table 2, item 14):

TABLE 3. (*Continued; foot notes*)

Test No.	Solutions					Elapsed time between preparation of the solution and its titration	Methyl orange: $n/5$ H_2SO_4 solution		
	Na_2HPO_4 (0.2%)	NaH_2PO_4 (0.2%)	$NaHCO_3$ (0.2%)	H_2O	Sodium mucinate		Found	Calculated	Difference
	c.c.	c.c.	c.c.	c.c.	mg.		c.c.	c.c.	c.c.
I	..	..	..	30	60	20 min.	0.15	..	..
II	10	10	10	..	..	20 "	1.70	1.65	0.05+
III	10	10	10	..	60	20 "	1.85	1.80	0.05+

These values show that the mucinate subtracted nothing from the basicity of Solution II, and that the basicity of Solution III, containing the same amount of sodium mucinate as I, was the sum of the basicities of I and II.

[a] The "found" titration value for the phosphate-bicarbonate solutions, prior to the addition of sodium mucinate (1–16), is 0.55 c.c. $n/5$ NaOH; the "calculated" value is 0.63 c.c. (See Tables 2 and 4.)

The proportion of sodium mucinate in each mixture containing it was 0.2%.

[3] The second and fourth paragraphs of the first foot-note under Table 2 apply also to the data in this table.

we have conducted the experiments with phenolthalein and methyl orange that are described below.

METHODS. *First series of tests.* We prepared aqueous stock solutions (0.2 per cent.) of di-sodium mono-hydrogen phosphate (Na_2HPO_4), mono-sodium di-hydrogen phosphate (NaH_2PO_4), and sodium bicarbonate ($NaHCO_3$). Portions of each, diluted and undiluted, and different combinations of them, were then titrated with standard acid or alkali solutions, with phenolthalein and methyl orange as the indicators (parallel groups). (See Table 2.)

Second series of tests. In a second series of tests the solutions referred to in the preceding paragraph were employed in the same way, with sodium mucinate added. Titration results for uniform quantities of sodium mucinate in equal volumes of water were obtained in control tests. (See Table 3.)

Third series of tests. The effects of various proteins on the titration values obtained in the first and second series of tests (described in the foregoing paragraphs) were determined in experiments similar to those of the second series. These proteins were (1) mucin, (2) sodium mucinate, (3) nucleoprotein, (4) sodium nucleoproteinate, (5) edestin, (6) gelatin and (7) egg

albumen. Products 1-5 were taken from residues prepared for previous researches in this laboratory; 6 and 7 were good commercial materials. Products 1 and 2 were derived from ox salivary glands; products 3 and 4 from yeast; the edestin from hempseed—by well-known methods, as described in various papers from this laboratory by Gies and collaborators.

RESULTS. The data in Table 2 show clearly that the titratable alkalinity of the mixtures, as indicated by methyl orange, is the sum of the alkalinities of the several constituents. *The same result was obtained in mixtures containing sodium mucinate.* (Table 3, foot note.) The data in Table 2 also show that the titratable alkalinities of mixtures of *basic* sodium phosphate and sodium bicarbonate, and the titratable acidity and alkalinity of mixtures of the two phosphates, as indicated by phenolthalein, are the sum of the alkalinities, or the difference between the acidity and alkalinity, respectively, of the two constituents, individually, in each of these two kinds of mixtures. The data in the same table (2) demonstrate, however, that the titratable acidity of mixtures of *acid* sodium phosphate and sodium bicarbonate, as indicated by phenolthalein, is *not* the difference between the acidity and alkalinity, respectively, of the two constituents, individually, of this mixture. The discrepancy between the "found" value and the "calculated" difference was greatest in the mixture containing the largest proportion of acid phosphate (Table 2, item 9). It is obvious, also, from the results of tests 25-29 (Table 2) that there was no tendency for the basic and acidic sodium phosphates (in the proportions taken) to react in any way to change the acidity of the mixtures. On the other hand, the results of tests 19-24 (Table 2) show clearly that the initial acidity of the mixtures of the basic and acid sodium phosphates and sodium bicarbonate gradually diminished until the solutions became slightly alkaline. In these mixtures (19-24) the acid phosphate evidently decomposed the bicarbonate with evolution of carbon dioxid, the latter reacting with, and affecting, phenolthalein until, by the time the later titrations were made, sufficient opportunity had been afforded for complete removal of the carbon dioxid. (See paper 1 in this series.)

The data in Table 3 show that the addition of sodium mucinate to the phosphate-bicarbonate solutions converted a titration value of 0.55 c.c. of *n*/5 alkali solution (1.1 c.c. *n*/10) into one ranging rapidly from 0.80 c.c. of *n*/10 alkali solution soon after preparation (Table 3, item 15) to 0.05 c.c. of *n*/5 *acid* solution (0.1 c.c. *n*/10) less than 2 hours afterward (Table 3, item 5). This change is more rapid than the similar progression in the comparable tests summarized in Table 2 (19-24), evidently due to an influence of the mucinate, which may conceivably react with one or more of the original constituents of the solution, or may accelerate the *formation* of carbon dioxid, or may combine with carbon dioxid in a way to "protect" phenolthalein from its action, or all of these.

The data in Table 3, for tests 19-26, emphasize the necessity of maintaining uniform conditions in such work, as was the case in these experiments, for the correct interpretation of the results of comparative titrations. They show, what is well known, that equal absolute quantities of acid or alkali, in different volumes of solvent, require, for obvious reasons, different though corresponding volumes of neutralizing solution to elicit an *indication* of neutrality.

That the reduction in the acidity of the phosphate-bicarbonate solutions by sodium mucinate was not an unusual effect is shown by the data in Table 4. This power was exerted by all the other proteins referred to in Table 4, except nucleoprotein and egg albumen. Each of the other proteins, after remaining for a few minutes in the phosphate-bicarbonate solution, reacted in such a way that the "found" acidity ultimately was less than the "calculated." In the tests of the effect of prolonged contact (Table 4, 13-14; 18-19) it was found that mucin and sodium nucleoproteinate behaved like sodium mucinate in this connection. The effect of increased temperature, within the biological range, on the "disturbing" influence of sodium mucinate, was shown very strikingly in tests 9 and 10 (Table 4).

3. Some effects of carbon dioxid on the turbidity of saliva.

Arnold Messing.

INTRODUCTION. Saliva as it occurs normally, in the mouth

TABLE 4.—DATA PERTAINING TO THE REACTION OF AQUEOUS SOLUTIONS OF VARIOUS PROTEINS (ALONE AND CONTAINING Na_2HPO_4, NaH_2PO_4 AND $NaHCO_3$), AS INDICATED BY PHENOLTHALEIN.

Test No.	Solution		Protein added to the solution	Titration values[1]			
	10 c.c. 0.2% Na_2HPO_4, 10 c.c. 0.2% NaH_2PO_4, 10 c.c. 0.2% $NaHCO_3$	H_2O	Kind (60 mg. of each)	Elapsed time between preparation of the solution and its titration	Phenolthalein: n/10 NaOH sol. Found	Calculated	Difference
	c.c.	c.c.			c.c.	c.c.	c.c.
A– 1	..	30	Na-mucinate	10 min.	0.05	..	..
2	..	30	"	20 "	0.05	..	..
3	30	..	"	10 "	0.80	1.10	0.30 −
4	30	..	"	20 "	0.60	1.00	0.40 −
B– 5	..	30	Na-mucinate	30 min.	0.05	..	..
6	30	..	"	43 "	0.30	0.80	0.50 −
C– 7	30	..	Na-mucinate	20 min.	0.65	1.00	0.35 −
8	30	..	"	22 hr.	*0.10*[2]	*0.10*	0
D– 9	30	..	Na-mucinate	2 "	0.50	(room	temp.)
10	30	..	"	2 "	0.15	(38-4	0° C.)
E–11	..	30	Mucin	At once	0.15	..	..
12	30	..	"	" "	0.90	1.25	0.35 −
F–13	30	..	Mucin	20 min.	1.10	1.15	0.05 −
14	30	..	"	24 hr.	0.10	0.05	0.05 +
G–15	..	30	Nucleoprotein	45 min.	0.05	..	..
16	30	..	"	45 "	0.60	0.80	0.20 −
H–17	..	30	Na-nucleoproteinate	At once	0.05	..	..
18	30	..	"	" "	0.75	1.10	0.35 −
19	30	..	"	23 hr.	0.10	*0.10*[2]	0.20 −
I–20	..	30	Edestin	40 min.	0.10	..	..
21	30	..	"	40 "	0.60	0.90	0.30 −
J–22	..	30	Gelatin	35 min.	0.25	..	..
23	30	..	"	35 "	0.65	1.15	0.50 −
K–24	..	30	Egg albumen	At once	0.05	..	..
25	30	..	"	" "	0.65	1.10	0.45 −

[1] The second and fourth paragraphs of the first foot-note under Table 2 apply also to the data in this table.
The "*calculated*" results represent the *theoretical* ("expected") titration values for the constituent volumes and substances, as derived *approximately* from the corresponding "found" data in Table 2, items 19–24, and from the water-protein controls in this table. Such calculations serve only as general indications. Data for n/5 solutions in Table 2 are used in the

immediately after secretion, is colorless and opalescent or turbid. When filtered immediately after its secretion, the turbidity of a given portion of saliva may be wholly removed, but such a salivary filtrate usually soon becomes turbid again, often almost immediately after collection. Such turbidities are apparently due to the precipitation of earthy phosphates and carbonates, as a result of the evolution of carbon dioxid and of the consequent removal of the solvent action of the latter. If this view is correct, it follows that the aeration of saliva—by removing carbon dioxid—would increase its turbidity, and also its alkalinity to such indicators as litmus and phenolthalein. It is equally obvious that the introduction of an excess of carbon dioxid might completely clarify turbid filtered saliva by redissolving the precipitated earthy phosphates and carbonates, provided it did not, at the same time, precipitate mucin from associated mucinate.

The bearing of these possibilities on the cause, nature, location, and progress of tartar formation on the teeth is plain. The experiments described below were intended to give us direct information on the points referred to above.

METHODS. Filtered fresh saliva (100 c.c) was divided into four equal portions. Each quarter-portion was opalescent and very slightly alkaline to red litmus. *One* portion, in a covered beaker, was kept on the laboratory table, untreated, at room temperature; a *second* portion, in a covered beaker, was warmed at 40 degrees C.; a *third* portion was aerated vigorously in a tall cylinder, the air prior to its passage into the saliva having been directed successively through concentrated sulfuric acid and

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calculations here as *n*/10 values. Thus, in the case of item 13, the "found" value (in Table 2), for the same period for the standard mixture, is 0.50 c.c. of *n*/5 alkali solution, *i. e.*, 0.50 × 2 = 1.00 c.c. of *n*/10 solution. The "found" value for the mucin control (Table 3, item 11) was 0.15 c.c. of *n*/10 alkali solution. The "calculated" expectation for item 13 is, then, on this basis of approximations, 1.00 c.c. + 0.15 c.c. = 1.15 c.c. of *n*/10 alkali solution, and is so recorded.

In the same way for item 14—the value for the standard mixture for the same time (nearest value, 20 hr.; Table 2, item 24), is 0.05 c.c. of *n*/5 acid solution, *i. e.*, 0.05 × 2 = 0.10 c.c. of *n*/10 acid solution; mucin control, 0.15 c.c. of *n*/10 alkali solution. Then, 0.10 c.c. of acid solution + 0.15 c.c. of alkali solution = 0.05 c.c. of alkali solution as the "calculated" titration expectation for item 14.

[a] The sodium mucinate solution became *alkaline* to phenolthalein in 22 hours; "*0.10*" signifies that 1 drop of *n*/10 sulfuric acid solution was required to discharge the pink color produced when phenolthalein was added. This change is in general harmony with that for tests 13–14 and 18–19, and was not due to putrefaction. See also tests 3–16, Table 3.

Italicized numerals (items 8 and 19) signify c.c. in terms of *n*/10 sulfuric acid solution.

sodium hydroxid solutions (in tall containers) for the removal of acid and basic fumes, such as ammonia and carbon dioxid; the *fourth* portion was treated with carbon dioxid from a Kipp generator, the gas passing gently through a tall column of 10 per cent. sulfuric acid solution prior to its entrance into the saliva. The periods of treatment were of equal length—approximately 2 hours. The four portions of saliva thus treated were compared, in beakers of equal size, especially with respect to degrees of turbidity. The tests were repeated frequently.

RESULTS. In each group of tests the aerated portion was more turbid than any of the other three. Its alkalinity to litmus was increased.

There was a lack of uniformity in the results for turbidity in the *remaining* three portions. That kept at room temperature was usually the clearest, or the same in turbidity as the portion treated with carbon dioxid; but sometimes the latter portion was the clearest of all. It was also observed that the portion warmed to 40 degrees C. tended to become clearer than any other in a given series, but that, when again cooled to room temperature, this portion acquired a turbidity that was invariably almost as great as that in the aerated portion.

These results indicate, in the first place, that aeration caused special turbidity of the saliva by removing carbon dioxid, thus increasing the alkalinity to litmus, and effecting precipitation of earthy phosphates and carbonates.

The clarification of the saliva warmed to 40 degrees C. was due, possibly, to the greater solubility at that temperature of any earthy phosphates, or carbonates, or colloidal aggregates (*e.g.*, mucinate), or all of these, that might have been present, or developed, as potential flocculent matter, during the period of filtration —and which, in the *control* portion at room temperature, gradually increased in quantity during the period of observation. The increased turbidity, after the warmed portion had been cooled again to room temperature, was probably due, on the foregoing theory, to a greater degree of reprecipitation of earthy phosphates, or earthy carbonates, or colloidal aggregates, or all of them, caused by the lowered content of carbon dioxid as a result of the

warming, with consequent diminution of solvent ("carrying") power. This general deduction is supported by the fact that such salivary mixtures, when rewarmed to 40 degrees C., became as clear, or nearly so, as they were at 40 degrees C. in the first place.

The variability in turbidity, in the portions treated with carbon dioxid, was apparently due to differences in the proportions and behavior of the contained mucinate (and other) particles which are responsible for the *opalescence* of normal saliva under dissimilar conditions of potential alkalinity or acidity. Thus, when the carbon dioxid treatment rendered the saliva more transparent than the control portion at room temperature, it probably did so by dissolving sufficient suspended earthy phosphate, or carbonate, or colloidal aggregates, or all of them, to induce the observed difference in favor of greater clarity. On the other hand, when the carbon dioxid treatment caused greater turbidity than that in the control portion, it presumably did so in saliva that was low in potential alkalinity (to litmus) by precipitating sufficient mucin to overbalance any earthy phosphate or carbonate simultaneously dissolved by it. In other words: Under different conditions of reaction to begin with, and in the presence of different proportions of earthy phosphate and carbonate particles and of dissolved mucinates, the acidity imparted by carbon dioxid was sufficient either to dissolve most or all of the suspended earthy salts (clarity), or to precipitate mucin from the dissolved mucinates (turbidity), or both, in different degrees with variable effects.

That carbon dioxid may precipitate mucin from saliva having a low potential alkalinity was shown conclusively, in a number of special experiments, with aqueous solutions of sodium mucinate that were practically neutral to phenolthalein. Two equal portions (25 c.c.) of a given solution (0.2 per cent.) of sodium mucinate were placed in small beakers. One portion was treated with a current of carbon dioxid gas, as in the experiments with saliva, while the other remained covered on a laboratory table, untreated, as a control. Almost immediately after the beginning of the treatment with the gas current, the mucinate solution began to grow turbid, cloudiness with flocculation increasing as the period of treatment lengthened. A repetition of this test, in which

the control portion was aerated with air that had been freed from carbon dioxid in the usual way, yielded identical results.

In the fourteenth paper of this series (page 400) additional data, bearing on these observations, are presented.

B. DATA REGARDING TESTS FOR SULFOCYANATE, GLYCOGEN, AND SUGAR.

4. A study of some factors of interference with the ferric chlorid test for sulfocyanate in saliva.

Louise C. Ball.

INTRODUCTION. It is well known, in a general way, that the "ferric chlorid test for sulfocyanate" is unreliable, when applied to saliva, both in its absolute and in its relative indications.[7] It is not known, however, just how many substances in normal and abnormal salivas interfere with this test nor to what degree each factor of interference, individually and in association with others, exercises its disturbing influence.

The experiments described below afforded the preliminary results, of a comprehensive investigation in this connection, on the interference exerted by some constituents of *normal* saliva. At an early opportunity this study will be extended, in this laboratory, to other constituents of normal saliva and also to constituents of pathological saliva, with the purpose of determining, by such analytic procedures as those described below, the essential reasons for the deficiencies of the ferric chlorid test for sulfocyanate in saliva; and in hope, also, of rendering the test perfectly satisfactory for accurate chemical inquiry.

METHODS. For the determination of the power of a given substance, *e.g.*, di-potassium mono-hydrogen phosphate, to interfere with this color test, many experiments of the kind described below were conducted.

A. Sixteen small porcelain crucibles were placed, four in a row, in solid-square formation and designated as follows, for convenience of record (1-16):

[7] Gies: *Dental Cosmos*, 1913, lv, p. 40; 1914, lvi, pp. 175 and 856.

Line	Column I	Column II	Column III	Column IV
Line A............	1	2	3	4
Line B............	5	6	7	8
Line C............	9	10	11	12
Line D............	13	14	15	16

B. The four crucibles in each horizontal line contained the same proportion of sulfocyanate, but the concentrations of sulfocyanate were successively less in each horizontal line from A to D. The four crucibles in each column contained the same proportion of phosphate, but the concentrations of phosphate were successively less in each column from I to IV.

C. The groups of liquids indicated in the appended summary were put into crucibles A, 1-4, in the *order* indicated by the sequence downward (a-e):

Line	Column (I)	Column (II)	Column (III)	Column (IV: control)
Line A............	1	2	3	4
Sequence of mixture / Substances used	c.c.	c.c.	c.c.	c.c.
a. KSCN (1-1000).	3	3	3	3
b. K_2HPO_4 (0.2%).	3	2	1	0
c. H_2O...........	0	1	2	3
d. HCl (10%).....	0.05	0.05	0.05	0.05
e. $FeCl_3$ (2%).....	0.05	0.05	0.05	0.05
Total volume......	6.1	6.1	6.1	6.1
Percentage of phosphate..........	0.1	0.07	0.03	0
Parts of sulfocyanate in each mixture...........................				1–2,033

D. The same volumes of each of the above named solutions were placed in the corresponding crucibles in the square (B-D), except for the following differences in the proportions of KSCN solution in the crucibles of each line.

Line B: Crucibles 5-8, 3 c.c. of 1-10,000 (present: approximately 1-20,000).

Line C: Crucibles 9-12, 3 c.c. of 1-50,000 (present: approximately 1-100,000).

Line D: Crucibles 13-16, 3 c.c. of 1-100,000 (present: approximately 1-200,000).

E. With the addition of ferric chlorid reagent to the contents of each crucible, and after thorough mixture with a stirring rod, there was or was not a typical *continuing* color effect, according to the nature and proportion of the interfering agent. In the appended summary of coloration effects induced by the addition of 0.05 c.c. (1 drop) of the ferric chlorid solution, the resultant color intensities are indicated by large numerals in an ordinary way, 10 representing maximum color, 0 no color, the intermediate numbers indicating intermediate shades; and the small subscript numerals reminding the reader of the positions of the crucibles in the square:

Line	Column			
	I	II	III	IV (control)
Line A............	0_1	2_2	4_3	10_4
Line B............	0_5	0_6	0_7	5_8
Line C............	0_9	0_{10}	0_{11}	3_{12}
Line D............	0_{13}	0_{14}	0_{15}	1_{16}

With the addition of successive drops of 2 per cent. ferric chlorid solution in this particular experiment (typical of procedure and results), the area of successive coloration effects was enlarged irregularly toward column I and toward line D. In other words, the coloration effects in the square as a whole (as the addition of ferric chlorid solution was made, a drop at a time, with mixture) were progressive in intensity from the crucible where the proportion of phosphate was largest and of sulfocyan-

ate was smallest (crucible 13)—diagonally across the field—to the crucible where the proportion of phosphate was smallest and of sulfocyanate was largest (crucible 4).

[In a criticism of Dr. Bunting's recent paper, entitled "Potassium Sulfocyanate in Saliva."[8] Dr. Gies, who opened the discussion, called attention to the fact that Dr. Bunting failed to consider the color of ferric chlorid itself in his proposed revision of a former modification of the old ferric chlorid test for sulfocyanate. Dr. Gies, in concluding his comment on this particular phase of the matter, asked: "Has he (Dr. Bunting) mistaken this (color of ferric chlorid alone) at any point for sulfocyanate coloration?"[9] In reply Dr. Bunting said: "*No dilution of ferric chlorid is anything but yellow* (*!*), and as the color of the ferric thiocyanate is red, the reaction may be clearly recognized, etc."[10] This statement about the color of ferric chlorid solutions must be a surprise to all who have used the reagent. The stronger solutions of ferric chlorid (a pure Kahlbaum product) used in these experiments (10–25%) were *reddish brown* in color. This was especially true of the 25% solution, the strength recommended by Dr. Bunting in the paper referred to above, a strength with which he himself was presumably familiar. No one would call these solutions yellow. The following statement on this point is typical of many in chemical text-books: "A concentrated solution of ferric chlorid has a *dark brown* color."[11]]

F. In the same way the interfering effects of the following additional substances (in the conditions indicated) were determined for each *individually:* mono-potassium di-hydrogen phosphate (0.2 per cent.), sodium bicarbonate (0.2 per cent.), and sodium mucinate (solid).

The effects of various *mixtures* of these substances were also ascertained, and the advantage of using ferric chlorid in higher concentrations (10, 15, 25 per cent. solutions) by substitution for 2 per cent. solution was studied.

In determining the effects of *mixtures* of these interfering substances, the plan of procedure accorded with that indicated by the following typical combination, at the beginning of an experiment, for a given line of crucibles (including a larger num-

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[8] Bunting: *Dental Cosmos,* 1914, lvi, p. 839.
[9] Gies: *Ibid.,* p. 857.
[10] Bunting: *Ibid.,* p. 866.
[11] Roscoe and Schorlemmer: A treatise on chemistry, 1907, ii, p. 1205.

ber of crucibles than that for the particular test referred to above):

Line	Column					
Line A	(I)	(II)	(III)	(IV)	(V)	(VI)
					(controls)	
Sequence of mixture — Substances used	1	2	3	4	5	6
	c.c.	c.c.	c.c.	c.c.	c.c.	c.c.
a. KSCN (1-10,000)	1	1	1	1	0	1
b. K_2HPO_4 (0.2%)	1	2	2	2	2	0
c. $NaHCO_3$ (0.2%)	1	1	1	2	2	0
d. Na-mucinate (mg.)	(5)	(10)	(15)	(20)	(20)	0
e. H_2O	3	2	1	0	1	6
f. KH_2PO_4 (0.2%)	1	1	2	2	2	0
g. HCl (10%)	0.05	0.05	0.05	0.05	0.05	0.05
h. $FeCl_3$ (10%)	0.05	0.05	0.05	0.05	0.05	0.05
Total volume	7.1	7.1	7.1	7.1	7.1	7.1
Percentage of K_2HPO_4	0.03	0.06	0.06	0.06	0.06	0
Percentage of KH_2PO_4	0.03	0.03	0.06	0.06	0.06	0
Percentage of $NaHCO_3$	0.03	0.03	0.03	0.06	0.06	0
Percentage of Na-mucinate	0.07	0.14	0.21	0.28	0.28	0

Parts of KSCN:

Crucibles 1-4 and 6, 1-142,858; crucible 5, none.

RESULTS. With the foregoing indication of the special ways and means of this study, the reader will be able to understand why it is impossible as well as unnecessary to present here the details pertaining to the mixture of substances in every crucible of every test of the dozens that were conducted. It will be sufficient, in the interest both of accuracy and of clarity, to present general deductions from the results, based, as each conclusion is, upon many concordant observations relating thereto.

Di-potassium mono-hydrogen phosphate, mono-potassium di-hydrogen phosphate, sodium bicarbonate, and sodium mucinate, individually and collectively, interfered with the sulfocyanate reaction with ferric chlorid under the conditions of these experiments. These interferences, so far as they related to the production of a discernible concentration of ferric sulfocyanate could be overcome, in the case of each substance and of each of the mixtures, by the addition of a chemical excess of ferric chlorid solution. The proportion of ferric chlorid required to produce

this " chemical excess " was different for the four substances involved. In some cases as much as three large drops of 25 per cent. ferric chlorid solution was necessary to effect it.

The quantitative differences among these substances, in this respect, have not yet been determined. The color in the presence of sodium bicarbonate was usually somewhat deeper and brighter, however, than that in the corresponding " water controls." This effect appeared to be due in part to direct reaction between iron and bicarbonate. The colors in the mixtures containing sodium mucinate (precipitated mucin) were lighter than those of the " water controls " because of the turbidity induced by the flocculent mucin. Tests of the effects of different amounts of sodium mucinate, the proportions of sulfocyanate being equal, yielded results that were practically identical—slight interference with color, almost wholly from the standpoint of resultant turbidity.

In different solutions of these substances, individually or collectively, containing equal proportions of sulfocyanate, a given uniform proportion of ferric chlorid failed to elicit colorations of equal intensity, the colors produced, if compared with a tinctorial standard, indicating unequal contents of sulfocyanate.

In experiments controlling the essential observations, it was found that larger additions of 10 per cent. hydrochloric acid solution than a single drop in the mixture in each crucible were without favorable effect on the results as described.

Many of the sulfocyanate colorations with the smaller proportions of sulfocyanate (*e. g.*, 1 — 350,000 and 1 — 700,000), were comparatively evanescent, often entirely disappearing in the control mixtures in about twenty minutes, and in all of the mixtures within an hour. The addition of more ferric chlorid failed to restore the coloration effects. This change, which is well known, is due to the action of light, in part at least. It was especially striking in the presence of an excess of the ferric chlorid reagent. Comparative tests with solutions exposed to the room light and with others kept in the dark, confirmed this point very strikingly, the solutions kept in the dark retaining most, if not all, their original tints for days.

5. Does saliva contain glycogen or glucose?

William A. Perlzweig.

INTRODUCTION. It has frequently been stated that saliva contains glycogen or glucose, or both.[12] In the light of the knowledge which recent and improved methods of research have afforded, it is doubtful whether either of these substances has been identified in saliva as often as has been supposed. Glycogen is so readily digested by salivary amylase (ptyalin) that it seems impossible for a moderate quantity of glycogen to remain in the oral secretions for more than a few seconds, even if it is normally secreted into the mouth. Bacteria and cells in general contain glycogen. If glycogen has ever been detected in saliva it is very probable that it was derived from oral bacteria or other salivary " form elements."

The evidence in favor of the occurrence of traces of glucose in normal saliva is similar to that pertaining to its presence in insignificant proportions in normal urine. That traces of glucose are secreted normally by the salivary gland is very probable. That glucose is secreted in traces from oral bacteria is also possible. That other reducing substances than glucose are present in saliva normally, and have been mistaken for glucose, is not impossible. That bacterial and cellular glycogen may be digested into glucose has just been noted. That glucose ascribed to normal saliva, on one or more past occasions, was derived from food residues is also a reasonable assumption.

We have endeavored, in the preliminary experiments described below, to investigate anew the questions indicated in the title of this paper.

METHODS. A. *Does saliva contain glycogen?* Portions (10 c.c.) of filtered, and also of unfiltered, saliva [13] were treated with various " iodin solutions "—viz., iodin in aqueous solution of potassium iodid, Lugol solution, and alcoholic tincture of iodin containing potassium iodid. The tests were controlled by parallel tests on very dilute aqueous solutions of pure glycogen, and

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[12] Kirk: *Dental Cosmos*, 1914, lvi, p. 1.

[13] The saliva used in these experiments was collected by two young men, both of whom were *markedly susceptible* to dental caries. Paraffin was masticated in order to stimulate the secretion. The saliva was used immediately after its secretion.

on distilled water. About twenty-five tests were made. In none of these did the saliva exhibit, in any degree, the characteristic red-brown color that is given by glycogen after the addition of one or two drops of any of the above-named iodin solutions. The control glycogen solutions reacted sharply. The iodin in the first few drops of the iodin solution was invariably absorbed by the saliva, without any accompanying change of color. A marked excess of iodin solution was required to produce a lemon-yellow coloration, which was intensified by further addition of solution. In no case, however, did the color become reddish-brown. The absorption of iodin was greatly reduced when we employed saliva that had previously been freed from mucin by precipitation with dilute acetic acid solution.

Some saliva was concentrated, on a water bath, to one-tenth of its original volume, but it also failed to give a test for glycogen. (It might be assumed, however, that this negative result was due to hydrolysis of any contained traces caused by the comparatively high temperature. If positive, the result would have been important.)

Pflüger's method [14] was applied twice. In the first case 100 c.c. (approximately 100 gm.) of filtered saliva were treated with 100 c.c. of 60 per cent. potassium hydroxid solution for three hours on a steaming water-bath, then diluted with an equal volume of water, and finally thrown into a double volume of 95 per cent. alcohol.

In the second case, 400 c.c. of saliva were first thrown into four volumes of 95 per cent. alcohol, with vigorous stirring, and the mixture allowed to stand for twenty-four hours. The resulting precipitate settled out by the end of this period and could be easily separated by decantation of the supernatant fluid. The sediment was taken up with enough water to bring the total weight to 100 gm. This mixture was subjected to the process described in the preceding paragraph.

In both cases, when the alkaline mixture was thrown into the alcohol, a turbidity was produced. In order to make precipitation more effective, a few drops of saturated sodium chlorid

[14] Grube: Abderhalden's Handbuch der biochemischen Arbeitsmethoden, 1910, ii, p. 164.

solution were added. The alcoholic mixtures were allowed to stand twenty-four hours, at the end of which period the precipitates formed flocculent sediments. The supernatant liquids were siphoned off; the sediments were transferred to 95 per cent. alcohol and the mixtures centrifuged. Neutral watery extracts were made of the resultant sediments.

In both cases iodin tests for glycogen in these watery extracts were wholly negative. Portions of these extracts were hydrolyzed with 5 per cent. sulfuric acid solution on a steaming water bath. Reduction tests, with Fehling and Fehling-Benedict reagents, gave wholly negative results.

B. *Does saliva contain glucose (reducing substance)?* (a) Qualitative tests. Tests on unfiltered, filtered, and on protein-freed saliva, invariably gave negative reduction tests with the Fehling, Fehling-Benedict, and Barfoed reagents. One c.c. of saliva and 5 c.c. of the reagent were used, as a rule, but larger volumes of saliva, 2-3 c.c. were employed, also with negative results. In none of the 30-40 tests performed was there produced even a turbidity in the first two reagents, but a white flocculent precipitate was sometimes formed in the Barfoed reagent. Mucin-freed saliva, concentrated on a water bath to one-tenth of its original volume, produced a slight turbidity with the Fehling-Benedict reagent, indicative of a very weak reduction.

(b) Quantitative tests. An attempt was made to apply to protein-freed saliva, the older Benedict method for the determination of glucose in urine.[15] Mucin was first precipitated in the cold with 2 per cent. acetic acid solution and filtered off. The neutralized filtrate was boiled, and then acidified with 2 per cent. acetic acid solution to remove coagulable protein. This latter manipulation presented difficulties, inasmuch as the final solution was usually turbid after repeated filtration, because of the failure of the coagulable proteins to agglutinate completely. No evidence of reduction in the reagent could be obtained by running even large amounts of this salivary filtrate from the burette.

Benedict's colorimetric method for the determination of small quantities of sugar in blood, as recently described by him[16] was

[15] Benedict: *Journal of the American Medical Association,* 1911, lvii, p. 1193.
[16] Lewis and Benedict: *Proceedings of the Society for Experimental Biology and Medicine,* 1913, ix, p. 57. We have used an unpublished modification, suggested by Benedict: picric acid instead of colloidal iron for the precipitation of proteins.

applied with greater success: To 10 c.c. of filtered saliva, 5 c.c. of saturated picric acid solution were added to remove the proteins. The following reduction results were obtained, *expressed* as *milligrams* of glucose per 100 c.c. of saliva (the various salivas had been obtained on different days):

Subject	Results		Subject	Results	
W—(a)	13.5		W—(a)	16.5	
" (b)	15.0	14.25	" (b)	15.5	16.0
" (a)	21.0		A—(a)	20.0	
" (b)	20.0	20.50	" (b)	19.0	19.5

General average, 17.6 (0.0176%)

In similar tests by other methods, Dr. Charles Weisman, cooperating in this laboratory with Dr. Gies, found that after dialysis of 25 c.c. portions of fresh normal saliva in collodion bags over night, the dialysates failed to react for glucose in the Molisch, Fehling-Benedict, and phenylhydrazin tests. Negative results with these tests for glucose were also obtained for salivary filtrates (each representing 30 c.c. of saliva) after the removal of proteins by treatment with acetic acid and ammonium sulfate, with basic lead acetate, or with cream of alumina. In one specimen of saliva, of several portions tested by each of the latter two treatments, there were indications, however, of the presence in the filtrate, of reducing substance. Application to the cream-of-alumina filtrate, of Kahn's method [17] for the quantitative determination of glucose (reducing substance), indicated the presence of 2.8 mg. of glucose (in 25 c.c. of saliva), or 0.0112 per cent.—practically the same proportion as the average value recorded above.

RESULTS. The foregoing description of methods has been facilitated by the inclusion, above, of statements regarding the details of the results. A brief general summary of results will be sufficient here, in conclusion.

Glycogen could not be found. Very slight and seemingly insignificant proportions of *reducing substance* were detected in *some* of the specimens of saliva. Although familiar "sugar methods" were used, it was not shown by them that the reduc-

[17] Kahn: *Biochemical Bulletin*: 1914, iii, p. 304 (Proceedings of the Columbia University Biochemical Association).

ing substance thus detected and determined was *glucose*. The concentration of *glucose* in these salivas, if *any* was present, could hardly have been equal to the insignificant proportions of reducing substance indicated by the figures recorded above.

6. Mucin and sodium mucinate reduce directly both the Fehling and the Fehling-Benedict reagents. A note on the possible origin of some of the "sugar" reputed to be present in normal saliva.

Arnold Messing.

INTRODUCTION. The facts stated in the introduction to the preceding paper in this series warrant the supposition that determinations of "sugar," in saliva, by the usual reduction methods, have possibly been confused, in more than one instance, by reductions due to unremoved mucinate. This possibility has been directly tested, as follows:

METHODS. In each of two series of tests, two equal portions of Fehling solution, also of Fehling-Benedict solution (50-75 c.c.), were placed in beakers of equal size, covered with watch glasses, and heated to boiling.

Into one of each pair of gently boiling portions of these solutions, in one series of tests, was dropped a small amount of mucin (50-100 mg.) and the boiling continued, for several minutes, with the beakers covered. In a second series of tests, sodium mucinate was added instead of mucin. Each series of tests was repeated.

RESULTS. Almost immediately after the addition of mucin or sodium mucinate, the alkalin copper solution receiving it in each case was heavily reduced, whereas the control solution was unaffected.[18] Most of the protein in each test remained undissolved—and over the surface of each particle there was a red deposit of reduced copper.

That mucin and its salts exert marked reducing action on these "sugar reagents" is very evident. That mucinate (and mucin) must be carefully removed completely, before the sugar (glucose) content of saliva can be determined by reduction methods, is obvious.

[18] In the case of Fehling solution there was a slight reduction in the control, but not sufficient to lead to any uncertainty on the main point.

That complete removal of mucinate and mucin, from solutions containing them, is not as easy as is generally believed, is well known to those who have given experimental attention to this matter.[19]

7. Is glycogen produced from mucin by the Pfluger-glycogen method, or glucose from sodium mucinate by the Lewis-Benedict glucose (blood) method?

William A. Perlzweig.

INTRODUCTION. The data of the preceding paper show that both mucin and mucinate, whether dissolved or suspended in the Fehling and Fehling-Benedict reagents, effect marked reduction of each of these solutions, which are now widely employed for the detection of reducing substances ("sugar"). These results suggest the possibility that any glycogen or glucose heretofore detected in saliva was derived from contained mucinate. The negative results for glycogen, as stated in the fifth paper of this series, render it improbable that glycogen or anything comparable to glycogen has ever arisen from mucinate in tests for glycogen. The results for content of salivary glucose, however, as stated in the same paper, were based upon methods that would probably have indicated, as glucose, any reducing substance derived from salivary mucinate, such as glucosamin. This criticism applies with equal force to all other methods previously employed for this purpose, rendering the experiments described below particularly pertinent and useful.

METHODS. *Does mucin yield glycogen?* Two portions of mucin, 1.85 and 2.2 gm., respectively, were each dropped into 6 c.c. volumes of water, then treated with 8 c.c. of 60 per cent. potassium hydroxid solution, and the rest of the Pflüger method [20] consistently applied.

The final precipitates in alcohol were centrifuged. The iodin reagents for glycogen referred to on page 374 were applied to concentrated solutions of these glycogen-like precipitates. *The results were negative in each case.*

The residual portions of the centrifuged alcoholic precipi-

[19] Gies: *Science*, 1907, xxv, p. 463.
[20] Grube: *Loc. cit.*

tates were thoroughly washed with alcohol, then hydrolyzed with dilute sulfuric acid solution. These liquids, after neutralization, were tested for reducing substance with Fehling-Benedict reagent. *The results were wholly negative.*

Does sodium mucinate yield glucose? Two portions of sodium mucinate (A-B), 30 mg. each, were dissolved (suspended) in 10 c.c. volumes of water. After the lapse of ample time for saturation of the water by the mucinate, the liquid was treated with 10 c.c. of saturated picric acid (*acidified with acetic acid*),[21] the filtrate diluted to 25 c.c., and the rest of the Benedict process applied,[22] with the following results for indicated glucose:

Sodium mucinate	Milligrams of reducing substance, expressed as glucose, from 30 mg. of sodium mucinate			
	1	2	Average	Per cent.
Portion A............	2.0	1.8	1.9	6.33
Portion B............	2.3	2.5	2.4	8.00

RESULTS. Large quantities of mucin failed to yield glycogen. Sodium mucinate, in quantities equal to those in 30 c.c. of normal saliva, yielded reducing substance equal to an indication of an average of 2.4 mg. of glucose—approximately the quantity recorded in the fifth paper of this series for a 25 c.c. fraction of saliva. Previously published results for salivary "sugar" were obtained by methods that were *less* effective for the removal of mucinate than the Lewis-Benedict process!

These findings necessitate suspension of belief in any available evidence indicating that saliva contains *glucose*, and require the complete and detailed investigation of the whole subject that is about to be undertaken in this laboratory.

C. PROPERTIES OF MUCIN.

Papers 6 and 7, in the preceding section, might have been appropriately placed under this head, but their practical relation to the determination of salivary "sugar" warrant their placement above.

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[21] Acetic acid was added to insure more complete precipitation of mucin.
[22] Lewis and Benedict: *Loc. cit.*

8. Does salivary mucin dissolve in soap solution?

Louise C. Ball.

INTRODUCTION. Soap is a constituent of many alkalin dentifrices. For this reason the effect of soap on mucin is a matter of special interest.

It is well known that the cleansing power of soap is due to its slight degree of alkalinity and to its emulsifying action. Mucin dissolves in dilute alkalin solutions: very slowly when in the form of dry masses, or of smears on solid surfaces; more rapidly when in the form of flakes. These facts indicated that mucin would dissolve in soap solution, to some extent at least, as the results of our experiments proved.

METHODS. In some preliminary tests, good toilet soap was pulverized and dilute aqueous solutions prepared. Small amounts of powdered mucin were added to portions of this slightly alkaline soap solution and, after frequent shakings, dissolved in them. When these soap-mucinate solutions were slightly acidified with hydrochloric acid, a flocculent precipitate was produced, which contained mucin, as was shown by the positive response of the precipitate to the biuret test for protein. (Acetic acid did not appear to serve as efficiently for precipitation as did hydrochloric acid.)

Soap powder and dry mucin were then triturated in a mortar with a little water. Both appeared to dissolve at once, in part at least. The filtrate, upon acidification with hydrochloric acid, yielded a precipitate that responded to the biuret test.

Finally, weighed quantities of soap and mucin powder were mixed in mortars in the following proportions:

	I	II	III
Soap (mg.)	50	25	100
Mucin (mg.)	50	100	25

Each mixture was triturated with a little water until homogeneity was effected; the liquid was then made up to a total of 100 c.c. and filtered—all under similar conditions. Filtration was slowest for the mixture containing most mucin (II), and was most rapid for the one containing least mucin (III)—facts implying different proportions of mucin (mucinate) in solution.

The major portion of each filtrate was treated with 0.2 per cent. hydrochloric acid solution, drop by drop, until precipitation appeared to be complete. The products thus obtained, which were flocculent in part and stringy in part, were assumed to contain mucin and fatty acid; they were accordingly thoroughly extracted with alcohol and ether for the removal of any fatty acid contained in them. (Treatment with ether made the masses doughy; alcohol made them granular.)

The alcohol-ether extract, when evaporated to dryness, yielded fairly large deposits. These deposits resembled fatty acid mixtures in general: they emitted fatty acid odors; were oily, partly crystalline; when suspended in alcohol, they reacted acid to phenolthalein; and, treated with 0.1 sodium hydroxid solution, they yielded soapy solutions, which emulsified neutral olive oil and gave a precipitate with calcium chlorid solution.

The residual portion of the original precipitate—the part that did not dissolve in the alcohol and ether employed for the removal of the admixed fatty acid—dissolved readily in 0.1 per cent. sodium hydroxid solution, from which it could be precipitated by slight acidification, and in which it gave the biuret reaction for protein.

Minor portions of the original soap-mucinate mixtures were carefully precipitated with hydrochloric acid as described above. The precipitates were found to differ somewhat in microscopic appearance; the product from mixture II (most mucin) consisted solely of *oily* globules; that from mixture III (least mucin) consisted *chiefly* of needles, with a few oily globules; that from mixture I (equal proportions of mucin and soap) contained needles (much smaller than those in product III) and globules, in approximately equal proportions.

Minor portions of the original soap-mucinate filtrates were also allowed to stand for several days in covered beakers, untreated, to test their keeping qualities. They remained unaffected for about three days, when fungi began to appear in filtrate II. In five days putrefactive odors were detectable, especially in filtrate II.

Results. Mucin dissolved in soap solutions of different degrees of concentration and alkalinity, from which it could be

precipitated with hydrochloric acid. The mucin products obtained in this way contained, also, fatty acids, which were likewise precipitated from their salts by the mineral acid. The *nature* of the mucinate in soap solutions will be determined in future experiments, together with the *degree* of solubility of mucin in standard soap solutions.

9. Experiments to determine the power of salivary mucin and its digestive products to combine with acid.

Leon Loewe.

INTRODUCTION. It has recently been said that "it seems evident that the power which the saliva possesses to rid itself of acids, and incidentally to exert a protective function against acid destruction of tooth structure, is not in any large degree, if at all, dependent upon chemical neutralization of the acid by the contained basic ions of the saliva, but is rather dependent almost wholly upon the precipitation by the salivary mucin as an acid-mucin coagulum." [23]

In a criticism of the paper containing this statement, Dr. Gies remarked that "none of this has ever been verified by experiment," and also said: "Any power exercised by salivary 'mucin,' as Dr. Kirk used the term (*i.e.*, by salts of the protein-acid, mucin), to neutralize acid, is due to the basic part of the mucinate; but the basic portion of salivary mucinate is much less in quantity than the proportionate yield of ash, which is only about 3 per cent. The amount of acid required to precipitate mucin from a neutral solution of its sodium salt (a typical mucinate) is little, if any, more than the quantity required to unite with all of the basic element in the mucinate. That mucin does not combine molecularly with acid to an appreciable degree, when acid precipitates it, is shown by the fact that, in the conventional methods for the purification of acid-precipitated mucin, all traces of the anion of the acid employed for the purpose may be easily flushed out of the precipitated product—and without any evidence of hydrolysis." [24]

Kirk also ascribed to mucin the power of forming an "acid-

[23] Kirk: *Journal of the Allied Dental Societies*, 1914, ix, p. 195.
[24] Gies: *Ibid.*, pp. 281 and 288.

mucin coagulum," and of effecting the "physical clearing of the saliva of its acid by means of the mucin coagulum," [25] a property which mucin does not possess, and an assumption that is chemically "fantastic." [26] These statements by Kirk were not supported by any chemical evidence presented by him; besides, he overlooked the fact that Gies demonstrated, eleven years ago, by methods then in vogue, "that mucins and mucoids do not show material combining power with acid—these (acid) glycoproteins are practically 'saturated' by their own acid radicals." [27]

In the experiments described below, we offer a further contribution to this subject.

METHODS. Suspensions were prepared containing, as a rule, 50 mg. of salivary mucin in 25 c.c. of distilled water. Control volumes, consisting of 25 c.c. of distilled water only, were used in comparison with the mucin suspensions. Each portion was kept in a small beaker. Hydrochloric acid solution (stock supply, 0.2 per cent.) was delivered, either by a particular burette or dropping tube, into the corresponding water controls, one drop at a time with consequent tests, until a response for *free* acid was given in each with freshly prepared Günzberg reagent. In performing the tests a drop of Günzberg reagent was evaporated to dryness, at a low temperature, in a porcelain evaporation dish and the tip of a glass rod, wet with the solution to be tested, was drawn over the Günzberg film, which was again desiccated—a red color in the dry matter indicating free acid. (It was found in preliminary tests that for this purpose this reagent was more delicate than that with tropeolin 00 and more convenient than that with collagen.)[28] Acid, equal to the total amount required by a "water control" to yield a test for *free* acid with Günzberg reagent, less one or two drops, was then added directly to the corresponding mucin suspension. More acid was then added, drop by drop, at intervals of approximately five minutes, until *free* acid was present, as detected by the Günzberg reagent. The

[25] Kirk: *Journal of the Allied Dental Societies,* 1914, ix, p. 197.

[26] Gies: *Ibid.,* pp. 281 and 287.

[27] Gies: *Ibid.,* p. 287; Proceedings of the American Physiological Society, *American Journal of Physiology,* 1903, viii (proceedings), p. xiii; also Gies and collaborators: *Biochemical Researches,* 1903, i, p. 54.

[28] Kanter and Gies: *Journal of Biological Chemistry,* 1911, ix; Proceedings of the American Society of Biological Chemists, p. xxvi.

difference between the amounts of acid consumed by the "water controls" and the corresponding mucin suspensions, respectively, *indicated the amount of acid combined with the mucin.*

To these different solutions and mixtures, containing a mere trace of the *free* acid, was now added a known amount (usually two drops) of freshly prepared pepsin solution (in the first experiments the strength of the solution was not known; in the later experiments the strength was 1 per cent. The mixtures, in some cases, were allowed to stand at room temperature, acid being added from time to time as the *free* acid disappeared by combination. In other cases the solutions were treated on water baths for half-hour periods at 38° C., and then allowed to stand as in the first case. The *additional* acid represented the amount consumed by the mucin during its *digestion*—*i.e.*, by the mucin digestive products, not by the mucin itself. In all these cases, as in the preceding ones, the controls were given the same treatment as the solutions under investigation. Controls on equivalent amounts of water, pepsin, and mucin, were conducted in each experiment.

RESULTS. The results of these tests are summarized in Table 5. They show that 50 mg. of mucin, in an experiment lasting thirty minutes, completely failed to combine with acid. During longer periods (two to three hours) this same quantity of mucin combined with a little less than the quantity of acid in about an ordinary drop of 0.2 per cent. hydrochloric acid solution—*i.e.*, 50 mg. of mucin combined with *less* than 0.15 mg. of HCl.[29] Even in an experiment *lasting twenty-four hours,* the amount of acid combined with 50 mg. of mucin was not greater than 0.4 mg. Expressed in terms of saliva, these results indicate that the "mucin" in about 50 c.c. of saliva (containing 50 mg.—0.1 per cent.—of mucin, as mucinate, a concentration that imparts marked viscidity, and which is approximately equal to the normal proportion) would be able to combine with a *maximum* of 0.4 mg. of hydrochloric acid. Since the combining power of such acids as lactic acid is much less than that of hydrochloric acid, this insignificant figure (0.4 mg. of HCl *for a period of twenty-*

[29] A determination of the exact strength of the acid, by titration with phenolthalein, showed that it contained 2.8 mg. of HCl per c.c.; one drop (0.05 c.c.) contained about 0.14 mg. of HCl.

four hours of contact) is subject to further shrinkage, if that is possible, when applied to " fermentation acids " of oral origin. This quantity of acid (0.4 mg. of HCl per 50 c.c. of saliva) is also much less than that required to remove (combine with) the basic part of the amount of mucinate corresponding to the mucin used (50 mg.); it is trivial compared with the amount of acid which the bicarbonates and phosphates (collectively) in the same volume of normal saliva (50 c.c.) are able to combine with—*i.e.*, to neutralize—and *this trifling amount of acid (0.4 mg. of HCl per 50 c.c. of saliva) could not possibly enter into combination with " mucin " or any other protein in saliva while the associated bicarbonates and phosphates remained unneutralized—i.e., alkaline to methyl orange.* Such simple chemical facts as these appear to have had no place in Kirk's thoughts when, overemphasizing the importance of mucin as an acid combiner, he wrote, in the paper already referred to, this astonishing statement:[30] "*It would be interesting to know in this connection just what alkaline salts exist in the saliva that are capable of neutralizing any acid*" (!)

TABLE 5.—DATA PERTAINING TO THE POWER OF SALIVARY MUCIN AND ITS PEPTIC DIGESTIVE PRODUCTS TO COMBINE WITH ACID (HCl).

Tests	Mucin	H_2O	Pepsin solution: P. D. & Co. (1:4000)		Duration of the experiment[1]	Total volume of 0.2% HCl involved (Günzberg)		
			Unknown concentration (more than 1%)	1%		Required to give test for *free* acid	Combined with	
							Mucin	Mucin digestive products
No.	mg.	c.c.	drops	drops	hours	c.c.	c.c.	c.c.
A— *1*	..	*25*	..	..	..	*0.17*	..	..
2	50	25	..	..	..	0.23	0.06	..
	50	25	2	..	1[2]	0.33	..	0.10[3]
	50	25	2	..	24[2]	0.53	..	0.30
3	50	25	..	..	..	0.23	0.06	..
	50	25	2	..	24[2]	0.40	..	0.17
4	..	**25**	**2**	..	**24[2]**	**0.23**	..	..
	..	**25**	**2**	..	**24[2]**	**0.23**	..	..

[30] **Kirk:** ***Loc. cit.,*** **p. 196.**

TABLE 5. (*Continued*)

Tests	Mucin	H_2O	Pepsin solution: P. D. & Co. (1:4000)		Duration of the experiment[1]	Total volume of 0.2% HCl involved (Günzberg)		
			Unknown concentration (more than 1%)	1%		Required to give test for *free* acid	Combined with	
							Mucin	Mucin digestive products
No.	mg.	c.c.	drops	drops	hours	c.c.	c.c.	c.c.
B— *5*	..	*25*	..	..	..	*0.06*	..	..
	..	25	2	..	3[4]	0.40	..	0.34
6	50	25	..	..	..	0.13	0.07	..
	50	25	2	..	3[4]	0.76	..	0.36
7	50	25	..	..	..	0.13	0.07	..
	50	25	2	..	3[4]	0.76	..	0.36
C— *8*	..	*25*	..	..	0.5[2]	*0.10*	..	..
9	..	25	..	2	24[4]	0.15	..	..
10	..	25	..	2[5]	24	0.15	..	..
11	50	25	..	..	0.5[2]	0.15	0	..
	50	25	..	2	0.5[4]	0.25	..	0.10
	50	25	..	2	24[4]	0.50	..	0.35
D—*12*	..	*25*	..	..	..	*0.20*	..	..
13	..	25	..	2	0.5[4]	0.25	..	..
14	50	25	..	..	24[2]	0.35	0.15	..
	50	25	..	2	3[4]	0.50	..	0.25

[1] Where time is not indicated, the duration of the experiment was either a matter of no consequence (water controls) or happened not to be recorded. In the latter instances the period of time involved was usually not more than an hour or two. The control tests, unless otherwise indicated in individual cases, were conducted at room temperature.

[2] These tests were conducted at room temperature.

[3] The amounts of combined acid (in c.c. of the standard solution) are calculated from the corresponding *control* data nearest to any given point in the table, the experiments having been conducted in the recorded sequence. Thus, the value of 0.06 c.c. for mucin in test 2 was obtained by subtracting 0.17 c.c. (1) from 0.23 c.c. (2). The value of 0.10 c.c. for "mucin digestive products" in test 2 (1 hour) was obtained by subtracting 0.23 c.c. (4—combined water and pepsin control) from 0.33 c.c. (2—1 hour).

[4] Of this period, 30 minutes was devoted to treatment of the mixture on a water bath at 40° C.

[5] The pepsin solution from which the two drops for test 10 were taken had been thoroughly *boiled*.

Although the results on combination with acid were practically negative so far as mucin itself was concerned, they were positive for mucin in the process of digestion—*i.e.*, for the products of peptic proteolysis of mucin. As peptic digestion proceeds, the protein involved is hydrated gradually into proteins of smaller molecular mass with increased affinity for *acid*, intrinsically per molecule and extrinsically also, because of the greater number of

available molecules. The data in Table 5 show that mucin is no exception to the rule in this respect.

Before undue emphasis is laid upon the particular figures of our practically negative findings for mucin, we propose to continue this study, with different acids, especially such as lactic, and with different mucin preparations; and also under various experimental conditions, especially such as would involve comparative titrations of large excesses of acid present from the beginning of the tests.

D. EFFECTS ON SECRETION.

10. An inquiry into the influence of cane sugar on the secretion of saliva, expressed in terms of volume, reaction, and content of mucinate.

G. H. Whiteford.

INTRODUCTION. Recent studies of dental caries and other dental diseases have emphasized the importance of an extension of our knowledge of the chemical physiology and pathology of "mixed *saliva," as it ordinarily occurs in the mouth.* For this purpose we need a method which is direct, accurate, and easy of execution, and also devoid of features that would be unpleasant for the subject supplying the secretion.

The method described below has been applied, with the aid of sugar solution, primarily to test the adequacy of the procedure for careful study of oral secretion.

METHODS. Measured volumes (5 c.c.) of water and sugar solution were taken into the mouth, and held there for a minute; then were directed into a small funnel supported in a graduated cylinder. The recovered volumes were compared with each other directly on a systematic basis. Comparisons of the recovered liquids were also made with respect to reaction and yield of mucin. Reactions were determined by titration in the usual way. Mucin was precipitated with dilute acetic acid (2 per cent.) and comparative turbidities noted.

RESULTS. The results of these experiments are recorded in Table 6. Under the head of "secretion periods" are indicated the successive volumes of liquids recovered at regular intervals of one minute, after the oral introduction of 5 c.c. volumes, the

figures in column 1 (H_2O) presenting the "control" recoveries, the figures in the sucrose column (2) showing the effects of sugar by comparison with the results in column 1, and the values in column 3 (after period) afford a second control (with water) and an indication, likewise, of the occurrence or absence of an "after-flow." The groups of observations by a given subject were conducted at intervals of about twenty-four hours.

For the first five groups the average volumes were the following:

No.	Subject	Secretion periods		
		1 H_2O	2 Sucrose (5%)	3 H_2O
I*	G. H. W.	5.4	5.9	5.7
II	G. H. W.	5.6	6.0	5.7
III	G. H. W.	5.6	6.1	5.8
IV	G. H. W.	5.6	6.0	5.7
V	A. M.	5.2	5.6	5.4
	General average...........	5.5	5.9	5.7
	Average increase..........	...	0.4	0.2

* Ten per cent. sucrose solution was used in this series of tests.

For group VI the averages (5.0, 5.4, and 6.0) indicate either a strong after-flow or represent a cumulative tendency caused by, or independent of, the sucrose. The larger quantity of sugar employed for the observations of group VII appeared to have no influence.

Titrations of the combined volumes for each of the three periods, in a group, yielded the following data (methyl orange the indicator):

No.	Subject	Secretion periods		
		1 H_2O	2 Sucrose (5%) (c.c. of $n/5$ H_2SO_4 solution)	3 H_2O
II	G. H. W.	0.30	0.35	0.25
IV	G. H. W.	0.20	0.30	0.25
	Average..................	0.25	0.325	0.25

These figures indicate a slight increase in the alkalinity of the saliva secreted in response to the sugar stimulus—an increase that was relatively somewhat more pronounced than the volume increase.

The individual volumes of groups I, III, V, VI, and VII were transferred to test tubes. The control liquids (1 and 3) were treated with equal volumes of 5(or 10)per cent. sucrose solution; the sucrose salivas (2) were treated with equal volumes of water. After each mixture had been shaken, all were treated with 2 per cent. acetic acid solution, drop by drop, for the complete precipitation of mucin. For each group, the volumes of the first of the two control series (1) were clearer than those of the second con-

TABLE 6.—DATA PERTAINING TO THE INFLUENCE OF SUGAR (SUCROSE) ON THE SECRETION OF MIXED SALIVA.

Group	Subject	Secretion periods		
		1	2	3
		H_2O	Sucrose (5%)	H_2O
No.		c.c.	c.c.	c.c.
I [1]	G. H. W.	5.6	5.9	5.8
		5.2	5.9	5.8
		5.4	6.0	5.7
		5.4	6.0	5.8
		5.3	5.8	5.6
(Average)		**5.4**	**5.9**	**5.7**
II	G. H. W.	5.8	5.8	5.8
		5.6	6.0	5.8
		5.5	6.2	5.6
		5.6	6.0	5.6
		5.6	6.0	5.5
(Average)		**5.6**	**6.0**	**5.7**
III	G. H. W.	5.8	5.5	6.3
		5.4	6.0	5.6
		5.6	6.2	6.0
		5.4	6.6	5.4
		6.0	6.1	5.6
(Average)		**5.6**	**6.1**	**5.8**
IV	G. H. W.	5.4	5.8	6.0
		5.6	6.0	5.8
		5.8	6.0	5.8
		5.6	6.2	5.6
		5.6	6.0	5.4
(Average)		**5.6**	**6.0**	**5.7**
V	A. M.	4.8	5.8	5.3
		4.8	5.6	5.4
		5.6	5.4	5.7
		4.8	5.6	5.4
		5.8	5.6	5.4
(Average)		**5.2**	**5.6**	**5.4**
VI	L. C. B.	4.7	5.2	5.8
		4.7	5.2	5.7
		5.4	5.6	5.8
		5.0	5.5	5.7
		...	...	...
(Average)		**5.0**	**5.4**	**6.0**
VII [1]	L. C. B.	5.3	5.3	5.4
		5.3	5.1	5.3
		5.3	5.4	5.3
		5.3	5.4	5.3
		5.3	5.4	5.3
		5.3	**5.3**	**5.3**

[1] The observations of Groups I and VII were conducted with 10% sucrose solution.

trol series (3), but the volumes representing the stimulation period (2) were more turbid than those of series 1 and 2—showing that the sugar stimulated the secretion of mucinate, and that the increase continued into the after period (3).

The constancy of the control data for each group, as recorded for "secretion period" 1, is a striking and suggestive feature of the results. The ease and accuracy with which mucin relationships and reaction changes can be observed is also noteworthy.

The method promises to be particularly useful for the study of the effects of many substances on the secretion of "mixed" saliva, and on the condition of the oral membranes and the teeth.

III. STUDIES PERTAINING DIRECTLY OR INDIRECTLY TO ENAMEL.

E. EXPERIMENTS ON ANIMALS, AND WITH NATURAL EXTRACTED TEETH.

11. Is it possible for liquid normally to pass from dentin to enamel, and vice versa? A preliminary note on the question of "nutritional" changes in enamel.

Leon Loewe.

INTRODUCTION. In his various annual reports to the First District Dental Society of New York, Dr. Gies has repeatedly urged attention to the possibility that enamel may be subject to special systemic influences, from the inside so to speak as well as from the outside, and that the incidence of caries might depend, in some cases at least, upon pathological modifications of nutrition that would be registered first in the dentin and subsequently in the enamel, or vice versa, according to the nature of the metabolic perversion. This view has been urged by Dr. Gies, not only with reference to teeth during the period of their development, but also, though in less degree, to teeth at any period thereafter. The work in this laboratory during the past year, under the auspices of the Dental Society of the State of New York, on the relation of internal secretions to the development and condition of the teeth, is an outcome of proposals along the lines of these possibilities.

The chief theoretical obstacle in the way of acceptance of the idea that enamel derives "nourishment," or is modified in various ways by influences, from the underlying dentin, is the difficulty of believing that nutritional liquid is able to pass, by any means, from the circulation in the pulp through the dentin into the under-surface of the enamel. If the passage of any substance, by this route to the under-surface of the enamel, could be shown to occur in *living* animals, the chief objection to acceptance of this nutritional theory would disappear—in fact the theory would then be an expression of reality.

It is not sufficient—perhaps it is useless—to ascertain whether substances may pass from dentin into enamel in *extracted* teeth; the conditions of passage in dead teeth are possibly so unusual—*i.e.*, so *favorable* to transit from dentin into enamel, that a positive result under such conditions would not be convincing biologically.

The experiments described below are the first of a series intended to solve this problem, if possible, by direct chemical attack in *living* animals.

METHODS. Aqueous solutions (0.5-10 per cent.) of trypan blue ("Trypanblau," Grübler) were injected (1-10 c.c.) intraperitoneally into one young albino rat, one young brown guinea pig, and two full-grown albino rabbits. Several such injections were made into the rat and guinea pig at intervals of 4-5 days; only one injection (10 c.c. of 10 per cent. solution) into each of the rabbits. When the injections were made the animals were in general anesthesia (ether).

No special toxic symptoms were shown by any of the animals, except the rat and guinea pig after the final injections (fourth for the former, third for the latter), which, for these animals, were 1 c.c. and 4 c.c., respectively, of the 10 per cent. solution. These final injections (of excessive quantities) caused the death of the rat and guinea pig in a few hours.

The external parts of the body of each animal became highly colored within an hour after the first injection, the intensity of blue pigmentation increasing speedily to a maximum after a given injection and, in the rat and the guinea pig, to a higher maximum after each successive treatment with trypan blue. The albino ani-

mals exhibited the most striking effects, the skin becoming blue all over the body (*e.g.*, ears, eyes, nose), and imparting a pronounced bluish white appearance to the whole animal. In the case of the rat, the blue showed distinctly through the hair in all parts of the body. Even the pink of each eye in the albino animals turned blue, as did the whites of the eyes. The gums, tongue, and oral membranes soon were deep blue. The urine was bluish to green. There was no secretion of pigment into the saliva, however, nor did pigment appear in the oral secretions—at all events, no color was imparted to filter paper pressed on the tongue, gums, and other oral surfaces. (Whether rabbits of this kind would lay blue Easter eggs has not yet been determined.)

Four days after the beginning of the experiment on the rabbits, when the general pigmentation was as general and as striking as at any time previously, they were killed by anesthesia with chloroform.

RESULTS. *Autopsy.* At autopsy the general observations were the same for the four animals. When the abdominal viscera were exposed, " everything " inside the body appeared to be a deep blue as if covered with a thick coat of blue paint—an astonishing effect when seen for the first time. The color was not superficially located, however, but permeated almost every part. The liver and spleen were greenish blue to greenish black throughout, the muscles and heart were bluish green, in irregular shades from very light to very dark. The kidneys, stomach, intestines, urinary bladder, subcutaneous tissues, skin, tendons, and ligaments, were various shades of deep blue. The bones were light blue or light green in some cases, deep blue in others—bone marrow was purple or blue. The bile of one rabbit was a brilliant purple. The urine and feces of both rabbits were bluish.

When dry, the under-side of the skin of the albino animals looked like dark blue leather.

These general effects are recorded here because they indicate that there was almost universal distribution and *detention* of trypan blue.

Among the apparent exceptions were the brain, spinal cord, and lungs, which seemed to retain their normal pigmentation. The lungs acquired a bluish green appearance, however, almost

immediately after the pleural cavity was opened, the color increasing gradually until it was dark blue in spots. The brain and cord, in their intrinsic parts (where lipins are the most abundant constituents) remained normal in appearance after long exposure to the air.

Teeth. The exterior of the teeth above the gums was unaffected, the white teeth standing out very strikingly against the blue background afforded by the gums, tongue, and oral membranes in general. The only exceptions were presented by the teeth of the rat, the enamel of the molars and the center of the occlusal surfaces of the incisors, appearing to be blue; the former light, the latter dark. (The rat received relatively the largest amount of trypan blue, which was injected on four different occasions during a period of two weeks.) The peridontal membranes were stained deeply blue. When the teeth were freed from adherent membranous matter, it was seen that the underlying surfaces of the teeth in all cases were stained deep blue, which in some places could be removed by vigorous scraping, in others could not be wholly removed in this way.

Cross sections of incisors and molars from each animal, prepared with a delicate scroll saw, were carefully examined with the aid of a large lens. It was found that in all cases the pulp had been stained a deep blue to bluish black, and that the dentin was similarly, though less intensely, pigmented. In some cases the pigment colored the entire mass between the dentin and the external enamel surface a pale, though perceptible blue, indicating that trypan blue had passed internally from the pulp through the dentin into the enamel, or externally from the alveolar membrane, or both. Occasionally it appeared that the pigment had traveled toward the outer surface of the enamel without attaining the full distance, for the section of the tooth showed a narrow irregular external line of uncolored material.

These observations are stated with the reserve that a profound ignorance of the histological conditions renders obligatory. The method promises, with the many extensions of these experiments we are about to inaugurate, to give important information on the broad problem we have attempted to solve. Before referring to the subject again, we propose to study, both chemically

and histologically, the effects obtainable with trypan blue and several other pigments.

12. An inquiry into the possible solution of calcium from enamel by products of putrefaction.

Arnold Messing.

INTRODUCTION. Current opinions regarding the action of putrefactive products on enamel agree in the conclusion that such substances are devoid of destructive power, primarily because of the alkalinity of the putrefactive medium. In this paper, and in several of the succeeding ones in this series, we have reopened this general question, with the purpose of reinvestigating the effects of various alkalin media and substances that result from putrefactive changes, and which are supposed to be without any destructive influence on enamel.

METHODS. Hashed ox heart, in portions of 100-150 gm., was allowed to putrefy spontaneously in three media: water (140 c.c.), physiological salin solution—0.9 per cent. NaCl—(140 c.c.), and 0.1 per cent. sodium carbonate solution (100 c.c.). After standing at room temperature for about three days, when each mixture was offensively putrid, sufficient water was poured into each mixture to make the total quantity of added fluid 300 c.c. The liquids were then filtered, the filtrates amounting successively to 225 c.c. (H_2O), 207 c.c. (NaCl), and 212 c.c. (Na_2CO_3). They were decidedly alkalin in reaction. Each filtrate was then diluted to 1 liter and bottled for use. Putrefaction tended to continue, of course, in each liquid thus prepared.

The quantities of calcium, in each volume of the final mixture of putrefactive products, was determined directly by the McCrudden method,[31] including final titration with *n*/20 solution of potassium permanganate, with the following results, per 100 c.c. of putrefactive filtrate:

A. H_2O solution...........0.90 milligram of calcium
B. NaCl solution...........0.72 " " "
C. Na_2CO_3 solution........0.97 " " "

These data served to control the subsequent findings for calcium.

Into 200 c.c. of each of the putrefactive media referred to

[31] McCrudden: *Journal of Biological Chemistry*, 1911, x, p. 187.

above were placed six or seven sound canine teeth from large dogs. The roots of the teeth had been sawed off, and the distal ends wholly covered with soft paraffin, which was applied in a molten condition, and extended in a thin though firm coat over the edge of the enamel, remaining closely in contact with it for an indefinite period, and thus removing all dentinal surface from exposure—conclusions that were verified by careful inspection in every instance, before and after treatment. The teeth were perfectly formed; the enamel luster was bright and uniform, before and after the test.

Results. The teeth were kept in the putrefactive media in covered beakers for four days. The mixtures were gently stirred repeatedly. At the end of that time, the glaze on the enamel appeared to be wholly unaffected. The liquids were subjected to direct analysis by the McCrudden method [32] for the determination of the contents of calcium, with the following results (per 100 c.c. of putrefactive filtrate):

A. H_2O solution...........0.97 milligram of calcium
B. NaCl solution...........0.97 " " "
C. Na_2CO_3 solution........2.72 " " "

The results for the first two solutions were practically the same as for the controls. The precipitate of calcium oxalate from the carbonate solution (C) was *visibly* contaminated with brownish matter that could not be washed out. This organic material obviously raised the apparent value for calcium by reacting like calcium oxalate with permanganate in the solution employed in the titration. In order experimentally to ascertain whether this surmise was correct, the tests with sodium carbonate solution were repeated in the following way:

Into each of two portions of 200 c.c. of the filtered sodium carbonate putrefactive solution in covered beakers were placed, nine of the teeth used in the previous tests; 120 c.c. of the solution (the residual portion) were kept for control purposes. After having been stirred gently now and then, for four days, the liquids were filtered. Again the teeth appeared to be unaffected. The "control" filtrate, and one of the filtrates from the media

[32] McCrudden: *Loc. cit.*

containing teeth, were oxidized by the Neumann method;[33] the filtrate from the second of the latter two media was kept in reserve, untreated. The quantities of calcium in both the oxidized and the unoxidized ("untreated") liquids were then determined, as before, by the McCrudden method, with the following results, per 100 c.c. of filtrate:

I. Filtrates from mixtures *containing teeth:*

a. Oxidized filtrate................0.27 milligram of calcium

b. Unoxidized filtrate..............0.76 " " "

II. Filtrate from control medium (*without teeth*):

c. Oxidized filtrate................0.34 milligram of calcium

These concluding results (I,a and II,c) indicate clearly that the previous values for calcium content were somewhat high. The difference between the results for I,a and I,b, shows that suspected contamination with organic matter caused the higher values for the first two series of tests—organic matter that could not be washed out of the precipitated calcium oxalate in the first two series, but which was wholly removed by complete oxidation in the concluding tests.

It is evident that these typical putrefactive media failed to dissolve calcium from the enamel of the teeth immersed in them.

13. Does ferric chlorid solution exert solvent action on enamel?

Louise C. Ball.

INTRODUCTION. Ferric chlorid solutions exert destructive action on enamel, as has often been noted after their therapeutic employment. Various reasons have been suggested for the deleterious effects thus produced, among them the influence of the acidity of such solutions. Ferric chlorid undergoes hydrolytic dissociation in water, in general accord with the principle shown by the following reversible equation:

$$FeCl_3 + 3H_2O \rightleftharpoons Fe(OH)_3 + 3\ HCl$$

The products of this reaction are unequally ionized, so that H ions predominate over OH ions, and consequently the solutions are *acid* in reaction.

[33] Thierfelder: *Hoppe-Seyler's Handbuch der physiologisch- und pathologisch-chemischen Analyse*, 1909, p. 539.

If the destructive action of ferric chlorid solutions is due to their acidity alone, then solutions of hydrochloric acid and of ferric chlorid of equal *titratable* acidities should, obviously, dissolve equal quantities of calcium from equal extents of enamel surface; or solutions of unequal *titratable* acidity should dissolve quantities of calcium from equal extents of enamel surfaces in proportion to their relative degrees of acidity. These possibilities were directly tested.

METHODS. A ferric chlorid solution was brought into equivalence with a 0.2 per cent. hydrochloric acid solution so far as acidity to phenolthalein was concerned. The strength of the ferric chlorid solution thus prepared was approximately 1 per cent. Into each of four beakers of equal size were placed 50 c.c. of water. To two of these volumes (pair A), were added 10 drops of the 0.2 per cent. hydrochloric acid solution; to the remaining two (pair B), were added 10 drops of the solution of ferric chlorid of equal acidity. Into each was placed one of the dog canine teeth referred to in the preceding paper. The teeth appeared to be perfect so far as enamel surface was concerned, and the paraffin coats on the distal ends completely covered the dentin. The four teeth were so nearly the same size, as a result of selection to that end, that the extent of enamel surface was practically equal for each pair of solutions. The liquids above the teeth were repeatedly stirred for twenty-four hours.

RESULTS. After twenty-four hours under the conditions indicated above, the enamel surfaces appeared to be unaffected, although the glaze on the tip of a tooth in one of the ferric chlorid solutions was less lustrous than it had been. In each beaker of pair B there was a slight precipitation of reddish material as if something (carbonate, phosphate?) from the tooth had reacted with the acid and precipitated some of the iron. (A second series of *control* tests, without teeth, failed to yield such precipitates, but analogous separations occurred when, at the conclusion of the control tests, 0.2 per cent. solution of di-sodium monohydrogen phosphate or calcium carbonate was added.)

The experiment was continued into the second day after a second addition of 10 drops of 0.2 per cent. hydrochloric acid solution to the volumes of pair A, and 10 drops of 1 per cent. ferric

chlorid solution to the volumes of pair B. The solutions were again repeatedly stirred. At the end of the second day there were no visible effects on the luster of the enamel surfaces. The dull surface at the tip on the tooth in one of the ferric chlorid solutions seemed to be as it had been. A third addition of 10 drops of acid and of ferric chlorid solution, respectively, to each of the corresponding pairs of liquids was then made and the experiment continued for a third day—again without *visible* effect on the enamel gloss; nothing was noted except increase in the amount of reddish precipitate in the beakers of pair B, the supernatant solutions being colorless. A fourth addition was made as usual. Soon, thereafter, it was noticed that the enamel luster began to diminish; two days afterward considerable corrosion had occurred and the surfaces looked chalky. The effects appeared to be slightly more pronounced on the teeth in the hydrochloric acid volumes than on the teeth in those that received ferric chlorid. It happened that the teeth had not been turned on any of the occasions when the liquids were stirred; it was found that the upper surfaces were corroded, but the under surfaces (against the bottoms of the beakers) were affected very little, in some places apparently not at all.

Forty drops of 0.2 per cent. hydrochloric acid solution had been added to each volume of pair A—*i.e.*, the equivalent of approximately of 2 c.c., making the concentration of hydrochloric acid in each volume of pair A about 0.008 per cent. On the same basis of calculation, the amount of added ferric chlorid was equal to about 0.04 per cent. The liquids (the supernatant portions) being colorless were filtered. Titration of 25 c.c. of each filtrate, in the presence of 1 drop of phenolthalein solution, gave the following results with $n/10$ sodium hydroxid solution:

Pair A (HCl): 0.5 and 0.55 c.c.
Pair B ($FeCl_3$): 0.55 and 0.55 c.c.

Aliquot parts of the residual volumes of each pair of liquids were mixed and of the total thus obtained for each pair, 40 c.c., in each case, were subjected to analysis for calcium by the McCrudden method.[34] The titration results with standard potassium

[34] McCrudden: *Loc. cit.*

permanganate solution were 0.9 c.c. for the calcium oxalate from each volume (40 c.c.), indicating the presence of 1.24 mg. of calcium.

The foregoing results make it evident that, under the conditions of these experiments, the observed corrosive action of ferric chlorid solution on enamel was due entirely to the acid in the solution. Similar experiments with larger proportions of acid and ferric chlorid solutions will be conducted at an early opportunity.

F. DATA PERTAINING TO TRI-BASIC CALCIUM PHOSPHATE, PRELIMINARY TO SPECIAL EXPERIMENTS ON ENAMEL AND DENTIN.

14. **On the solvent action of carbon dioxid on calcium carbonate and tri-basic calcium phosphate suspended in water, saliva, and sodium mucinate solution.**

Arnold Messing.

INTRODUCTION. The results of the first and third papers in this series emphasized the importance of more complete knowledge regarding the influence of carbon dioxid in the saliva, and on the teeth and oral membranes. The ease with which carbon dioxid may be removed from saliva by aeration, and with which it escapes spontaneously; the readiness with which it emerges from bicarbonate in reaction with acid phosphate and mucin; and the facility with which earthy phosphates and carbonates separate from saliva as associated carbon dioxid is removed therefrom, are impressive facts that bear intimately on the processes of tartar formation.

In addition to the results in papers 1 and 3 of this series, on certain negative phases of this particular matter, we have sought positive evidence regarding the solubility of earthy phosphate and carbonate, in media containing carbon dioxid and comparable to the saliva; in the hope, also, that the data thus obtained would afford practical suggestions for similar studies of enamel and dentin.

METHODS. Carbon dioxid, freshly evolved in a Kipp generator and directed cautiously through a wash-bottle containing sulfuric acid solution (10 per cent.), was passed into 25 c.c. volumes of water, filtered saliva, and solutions of sodium mucinate (0.2 per cent.), containing weighed amounts of tri-basic calcium phosphate or calcium carbonate (traces to 100 mg.), for periods

of fifteen to forty-five minutes. Equal quantities of the phosphate and carbonate were simultaneously mixed with water, saliva, and sodium mucinate solution (-0.2 per cent.) in separate "control" tests devoid of treatment with carbon dioxid. One control set was aerated with air free from carbon dioxid.

At the conclusion of the aeration procedure, each set of liquids was filtered. Measured volumes, or the entire filtrates, in directly comparable tests, were used for qualitative determinations of the presence or absence of calcium. In the tests with saliva and sodium mucinate solution, the filtrates were subjected to thorough oxidation by the Neumann method [35] prior to the detection of calcium, which, in all the tests, was precipitated, as oxalate, by the McCrudden process.[36]

RESULTS. The control filtrates always yielded, by this method, very slight almost inappreciable quantities of calcium oxalate, whereas the filtrates from the water and mucinate mixtures through which carbon dioxid had been passed yielded calcium oxalate in comparative abundance. In many cases the differences were very striking. Suspensions of slight quantities of either the phosphate or the carbonate in water were speedily clarified. The yield of calcium oxalate was always somewhat more conspicuous in the water tests than in the sodium mucinate experiments; the yields in the latter were much more marked than those in the saliva. Occasionally it was doubtful whether the yield of calcium oxalate from the salivary mixture was as great as that from the control.

It was evident throughout the experiments that calcium carbonate yielded more calcium to the carbonated media than did tri-basic calcium phosphate.

When the filtrates from the carbonated mixtures were warmed to 40° C., turbidity ensued as carbon dioxid was expelled.

These results were so striking that quantitative determinations were unnecessary in all but a few cases. The comparatively negative results with saliva suggest repetitions of the experiments

[35] Thierfelder: *Hoppe-Seyler's Handbuch der physiologisch- und pathologisch-chemischen Analyse,* 1909, p. 539.

[36] McCrudden: *Loc. cit.*

so far as they pertain to saliva, with special reference to quantitative discriminations and to the explanation of the "protective" action observed. Such experiments will be inaugurated in the near future.

15. Experiments to determine whether salivary mucin is able to dissolve calcium from tri-basic calcium phosphate.

Leon Loewe.

INTRODUCTION. Mucin, as ordinarily prepared from saliva, is a protein that is both weakly basic and strongly acidic. It is, in effect, a polyhydric acid. It yields acid, neutral, and alkalin salts. It occurs in normal saliva in the form, as a rule, of mixtures of acid salts of different degrees of acidity.

Mucin dissolves in a solution of sodium carbonate, disengages carbon dioxid as it goes into solution and, if the *mucin is present in chemical excess,* it completely neutralizes the sodium carbonate solution. The filtrate, from such a mixture, contains mucin in the form of *acid* salts—*i.e.,* acid mucinates. If the solution is evaporated at a low temperature, and the dry residue is treated with dilute sodium carbonate solution, carbon dioxid is again disengaged and continues to evolve, *in the presence of an excess of carbonate,* until the acid mucinate is converted into *neutral* or alkalin mucinate.[37]

These facts warrant the opinion that acid mucinate, if deposited on teeth, would tend to dissolve calcium and other basic elements from the enamel.

As a preliminary to studies of the effect of mucinate on enamel, the following experiments were conducted:

METHODS. Determinations of any solvent action that salivary mucin may exert on tri-basic calcium phosphate were conducted, in their preliminary phases, by two different procedures: (A) The substances involved in the tests were mixed in known volumes of water in beakers; or (B) were triturated in a mortar with small amounts of water to the consistency of thin paste before their transferral, at once or some hours later, to known

[37] This brief summary pertaining to the qualities of mucin is based upon the results discussed in numerous publications, from this laboratory since 1899, by Gies and collaborators.

volumes of water (100 c.c.) in beakers, thus insuring more direct and intimate contact than by procedure A. Each mixture obtained by either procedure was repeatedly stirred for three to twenty-four hours, after which the liquids were filtered. Filtration was facilitated, whenever desirable, by the addition of water in measured volumes to each mixture of a series. In every case

TABLE 7.—DATA PERTAINING TO THE POWER OF MUCIN TO DISSOLVE CALCIUM FROM TRI-BASIC CALCIUM PHOSPHATE.

Test	Total volume of H_2O	Mucin	Sodium mucinate	$Ca_3(PO_4)_2$	Relative yields of calcium oxalate in the filtrates [1]
No.	c.c.	mg.	mg.	mg.	
I— 1	50	50	..	..	+ (control)
2	50	50	..	50	++++
3	50	50	..	50	++++
4	50	..	..	50	+ (control)
II— 5	100	50	..	50	++++
6	100	50	..	50	++++
7	100	..	..	50	+ (control)
III— 8	100	..	50	..	++ (control)
9	100	..	50	50	++
10	100	..	50	50	++++
IV—11	100	250	..	..	+ (control)
12	100	250	..	100	++++++
13	100	250	..	100	++++++++
14	100	..	..	100	++ (control)
V—15	100	250	..	100	++++
16	100	250	..	100	++++
17	100	500	..	200	++++++++

[1] The + marks are indicative only of *relative* differences *independently in each group*. The results were so striking that quantitative procedure was unnecessary.

filtration was repeated until the filtrate was entirely clear or opalescent. The filtrates were then transferred to 800 c. c. Kjeldahl flasks, and the contained matter completely oxidized by the Neumann method,[38] prior to the precipitation of calcium by the McCrudden process.[39]

[38] Thierfelder: *Loc. cit.*
[39] McCrudden: *Loc. cit.*

Results. The details of the tests, and the results of each, are indicated in the accompanying summary (Table 7). The greatest degree of solubility of calcium was obtained in the mixtures that were triturated in a mortar.

That mucin dissolved calcium from tri-basic calcium phosphate was very evident. That mucin is able to dissolve calcium from enamel is highly probable.

16. On the extraction of calcium from tri-basic calcium phosphate by various salivary salts and mixtures thereof.

G. H. Whiteford.

Introduction. Dental caries arises from the influence of factors wholly *external* to the tooth involved, or from the influence of factors wholly *internal* to the tooth, or from the action of both external and internal factors. If the agents and conditions that inaugurate or influence caries are entirely, or in part, external, it may be reasonably supposed that they arise from, or at least are modified by, the "mixed saliva." It is currently regarded as practically certain that the primary factor in the causation of caries is the exposure of dentin, as a result of the solution of overlying enamel, by acid arising from the fermentation of adjacent (lodged) carbohydrate. It is further generally believed that the saliva exercises a restraining influence, or even a completely protective action in many cases, because, among various reasons, its basic materials tend to neutralize all or some of such destructive "fermentation acid," thus diminishing, and in some mouths perhaps wholly preventing, the destructive action of acid produced in this way. This view includes the broad assumption that saliva itself has no solvent action on enamel, and that none of its individual constituents exercises any such solvency. This general assumption, especially so far as it includes the acid phosphates, lacks the broad experimental basis such a theory requires. The experiments described below (which are analogous to those in the preceding paper in this series), although they relate only to tri-basic calcium phosphate, are intended as a preliminary to similar inquiries regarding enamel and dentin.

METHODS. Portions of the residual supplies of the solutions of di-sodium mono-hydrogen phosphate, mono-sodium di-hydrogen phosphate, and sodium bicarbonate, that were used for the work described in the second paper of this series, were measured into covered beakers; equal total volumes of mixtures of these were also prepared in beakers. Into the beakers were placed weighed quantities of powdered tri-basic calcium phosphate. The mixtures were stirred occasionally during a period of twenty-four hours. At the end of that period the liquids were filtered, and their contents of calcium determined by the McCrudden method,[40] with final titration with a standard potassium permanganate solution. The tests included a repetition, with solutions of the kind named above, at a concentration of 0.4 per cent.

RESULTS. The details pertaining to the mixtures, and the results, are summarized in Table 8. Ignoring temporarily a few discordant values (1-12, 8-19), we see, from the data in that table, that the acid phosphate exerted marked solvent action, and that its tendency in this direction was not fully restrained by the more basic salts that were mixed with it in some of the tests (5, 7, 8, 16, 18, 19). The proportions of salts in tests 8 and 19 were quite analogous to those in amphoteric salivas. The mathematical differences recorded in Table 8 are not as impressive, on these points, as the observed differences among the precipitates that were noted as the oxalate formed and sedimented. The disagreements between results 1 and 12, and between 8 and 19, may be due to analytic error; on the other hand, differences in room temperature and greater concentrations of the salts involved may be responsible for them.[41] The same may be said of the fact that the strongly positive result for test 3 is not exceeded in test 14.

Lack of time prevented the repetitions and extensions of these tests that the preliminary results have rendered desirable, but further work along this line will be included in the proposed investigation of enamel and dentin under similar conditions.

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[40] McCrudden: *Loc. cit.*

[41] The observed discordance was due, in part, to titration of the first group of acid calcium oxalate solutions after they were cooled instead of while they were hot.

TABLE 8.—DATA PERTAINING TO THE SOLUTION OF CALCIUM, FROM TRI-BASIC CALCIUM PHOSPHATE, IN SOLUTIONS OF Na_2HPO_4, NaH_2PO_4 AND $NaHCO_3$, INDIVIDUALLY, IN PAIRS AND IN TRIOS.

Test	Water	Na_2HPO_4 (0.2%)	NaH_2PO_4 (0.2%)	$NaHCO_3$ (0.2%)	$Ca_3(PO_4)_2$	Dissolved calcium	
						Standard permanganate solution	Ca
No.	c.c.	c.c.	c.c.	c.c.	mg.	c.c.	mg.
A— 1	150	..	..	..	100	0.10	0.14
2	..	150	..	..	100	0.05	0.07
3	..	..	150	..	100	3.35	4.62
4	..	..	..	150	100	0.15	0.21
5	..	75	75	..	100	0.20	0.28
6	..	75	..	75	100	..	..
7	..	..	75	75	100	0.40	0.56
8	..	50	50	50	100	1.50	2.07
9	..	150	..	..	..	No oxalate	(control)
10	..	..	150	..	..	" "	(control)
11	..	..	..	150	..	" "	(control)
		(0.4%)	(0.4%)	(0.4%)			
B—12	150	..	..	..	500	0.65	1.00
13	..	150	..	..	500	0.15	0.21
14	..	..	150	..	500	2.50	3.45
15	..	..	..	150	500	0.20	0.28
16	..	75	75	..	500	0.35	0.48
17	..	75	..	75	500	0.25	0.35
18	..	..	75	75	500	0.50	0.69
19	..	50	50	50	500	0.40	0.56

IV. SUMMARY OF GENERAL DEDUCTIONS.

WILLIAM J. GIES.

The following general deductions are among those that are warranted by the results in the foregoing papers (1-16): [42]

(1) Neither the actual (electrometric) nor the potential (titratable) reaction of a specimen of saliva can be accurately determined, *after boiling or aerating it,* because both processes accelerate the decomposition of soluble bicarbonate and facili-

[42] Numerals in parenthesis in this summary refer the reader to the "results" of the corresponding paper in the series.

tate the removal of ***resultant*** carbon dioxid (as well as of carbon dioxid previously "free"), thus reducing the proportion of acid radicals and increasing the basicity of the residual liquid.

The potential (*titratable*) reaction of saliva is its most significant reaction. It is the reaction that supports the *actual* reaction and determines, so far as reaction can, the degree of attack upon, or protection of, the teeth by the salivary constituents. For this reason any method of determining the total acidity of saliva, such as Bunting has been using, that fails to include all the contained carbon dioxid, both "free" and "combined," is inaccurate.

(2) Methyl orange appears to be an excellent indicator of the total *titratable* basicity of saliva. The titratable *alkalinity* of mixtures of leading salivary constituents, including bicarbonate and mucinate and as indicated by ***methyl orange,*** was the sum of the titratable alkalinities of the individual constituents.

The total titratable *acidity* of such mixtures of leading salivary constituents, including mucinate and as indicated by ***phenolthalein,*** was *less* than the difference between the titratable alkalinities and acidities of the individual constituents, evidently because of interreactions that involved loss of acidic radicals (CO_2?). The degree, nature, and variabilities of such interactions must be determined before we can fully comprehend just what "total acidity" signifies when ascertained with the aid of phenolthalein.

The acidity, to ***phenolthalein,*** of such mixtures of leading salivary constituents gradually decreases, until alkalinity is attained, evidently as an outcome of the interreactions that result in expulsion of carbon dioxid. The bearing of this fact on the utility of phenolthalein is obvious.

(3) Differences in the turbidity and opalescence of fractions of fresh, normal saliva are due, in large degree, to differences (variations) in the contents of soluble bicarbonate and carbon dioxid. Differences in the proportions of these constituents may cause turbidity or opalescence for two different reasons —by precipitation of mucin, when the retained proportion of carbon dioxid is excessive ("acid saliva"); by precipitation of earthy phosphates and carbonates, when the retained proportion

of carbon dioxid is subnormal ("alkaline saliva"). The proportion of carbon dioxid that effects the greatest degree of transparency has not yet been determined (14).

(4) The leading constituents of saliva, collectively and individually, interfere more or less with the ferric chlorid reaction for sulfocyanate, because of their preferential reaction with this reagent. Such interference is diminished or overcome by the presence of moderate excesses of hydrochloric acid and ferric chlorid. The test is unreliable for several reasons. For quantitative determinations, on a basis of comparisons with tinctorial standards, it cannot be accurate unless variables are either not present to begin with or are wholly removed, including the evanescence of the colorimetric standard itself. "Variables" are present in every specimen of saliva.

(5) Tests for glycogen in saliva were wholly negative (7). Normal saliva may contain very slight proportions of reducing substance (6, 7).

(6) Mucin and mucinate exert powerful reducing action, each simulating glucose in this respect. Glucose cannot be accurately determined in saliva by a reduction method unless the contained mucinate (mucin) is wholly removed (5, 7).

(7) Glycogen could not be obtained from mucin. Acid precipitation of mucin from a solution of *sodium mucinate* left a filtrate with appreciable reducing power, a fact that shows the difficulty of removing all the mucin from a portion of saliva to be subjected to analysis for glucose by a reduction method. and suggests that the *glucose* reputed to occur in normal saliva may be a myth (5, 6).

Theories on the cause of dental caries, that are based on the "glucose" (?) content of saliva, are not warranted by present knowledge in this regard (5, 6).

(8) Mucin is soluble in soap solution, and may be precipitated therefrom, in part at least, by simple acidification. The precipitate thus produced contains fatty acid.

Soap solution is not as effective a solvent of mucin as is sodium carbonate or lime water. None of these alkalin media readily dissolves mucin in hard deposits or adhesive smears, though they do so when the available mucin is flocculent. Soap

can hardly be of special use, in dentifrices, as a solvent of mucin, because of the mechanical difficulty of directing soap solution, in the mouth, *into* mucin plaques and smears.

(9) Mucin did not combine with hydrochloric acid to any significant degree. The peptic digestive products of mucin did so, with cumulative affinity, as digestion proceeded.

Kirk's theory, to the effect that mucin protects the teeth by "physically clearing the saliva of its acid by means of the mucin coagulum," never had an experimental or chemical justification, and ignores contrary findings, such as the one referred to in the preceding paragraph, that were well known fifteen years ago.

(10) Cane sugar was found, by a simple, direct, and convenient method, to stimulate the flow of saliva, increasing volume, alkalinity and content of mucinate.

(11) Trypan blue, after its intraperitoneal injection into a young rat, a young guinea pig, and two full-grown rabbits, appeared in the pulp and dentin of all the teeth, and apparently was absorbed to some extent, also, into the enamel. (This deduction regarding enamel is stated with reserve, but histological study of the teeth is expected to remove any doubt in the matter.) The exterior of the teeth above the gums was unaffected.

(12) Putrefactive media were without effect on the enamel of canine teeth from dogs; calcium was not extracted from these teeth by such media.

(13) Any destructive action that pure ferric chlorid solutions exert on teeth appears to be due solely to the hydrochloric acid (hydrolytic) in them.

(14) Carbon dioxid, directed into water containing calcium carbonate or tri-basic calcium phosphate, dissolved these compounds by converting them into the corresponding acid salts. Removal of the carbon dioxid from filtrates from such mixtures resulted in reprecipitation of the original insoluble substances, the disappearance of the carbon dioxid inducing return to the basic form of each. These changes occur in solutions of sodium mucinate (0.2 per cent.), but such suspensions in saliva are less subject to the solvent action of carbon dioxid, possibly because of a "protective" action (15, 16).

Tartar formation on the teeth may vary in kind, degree, and

location with variations in the proportion (activity) of free carbon dioxid (3).

(15) Mucin dissolves calcium from tri-basic calcium phosphate. Mucin and acid mucinates probably exert similar action on enamel and dentin (14, 16).

(16) Acid phosphate (NaH_2PO_4) exerted marked solvent action on tri-basic calcium phosphate. Its tendency in this direction was not fully restrained by the amounts of di-sodium mono-hydrogen phosphate and sodium bicarbonate that were mixed with it in some of the tests. This effect was evidently caused by exchange of hydrogen for calcium, with consequent production of soluble calcium phosphate.

It is probable that acid phosphate exerts similar action on enamel and dentin, and that amphoteric saliva does so on teeth.

LOCAL ANESTHESIA[1]

BY PROFESSOR DR. GUIDO FISCHER, MARBURG, GERMANY.

One of the most noble tasks of the physician is the relief of pain. This explains why so much care has been devoted in all ages by members of the healing art to the subject of anesthesia, both general and local. As medical science advanced, either one of these methods occupied the foreground of interest. General anesthesia, for a long time enjoyed greater popularity, but the discovery of safer substitutes for cocain, and of the extract of the suprarenal gland a few years ago, brought about a great change in favor of local anesthesia. For dentistry, these discoveries have been of marked importance, because in this branch of science the troubles and dangers of general anesthesia were, in the majority of cases, entirely out of proportion to the gravity of surgical interference. It is, therefore, a blessing for suffering humanity that we can now abolish sensibility with absolute certainty and without any risk to the patient's life. The degree of perfection which we have reached in this domain, I wish to demonstrate to you theoretically as well as practically, and it is my fondest hope that I may succeed in gaining a large circle of advocates for this method on this side of the ocean.

When, in 1884, the Swiss surgeon, Koller, demonstrated in Heidelberg the great anesthetizing power of cocain, the enthusiasm over this newly discovered agent ran high, and local anesthesia rapidly gained ground in all countries. Every branch of medicine tried to profit by its advantages, and dentistry, like the rest, took up this method, though not without hesitation. But the experiences were too recent, and the properties of cocain so little known that, very soon, serious cases of intoxication and deaths, following injections of cocain, were reported. This was a severe blow to local anesthesia, and under the influence of such a marked series of failures, it was dropped, while general anesthesia was more and more perfected. Though it was demonstrated that, by dilution, cocain solutions could be

[1] Read at a special meeting of the First District Dental Society, S. N. Y., March 19, 1914. See disc., p. 482.

rendered less toxic, their use was not again adopted generally until much later.

It was the discovery of the suprarenal preparations which marked a turning point in the history of local anesthesia. In 1901, Takamine and Aldrich, two American research scientists, independently of each other, succeeded in isolating the active principle of the suprarenal glands of sheep and oxen, and prepared it in crystalline form. The organic product is called adrenalin, and the synthetic product, suprarenin, the action of the two being identical. Braun, the well-known surgeon, quickly recognized the vital importance of this agent, and he adopted it for local anesthesia. He succeeded in combining an anesthetic with the suprarenal preparation, and this mixture inaugurated the victory of local anesthesia, and brought about the unexpected perfection of this method. Adrenalin's most remarkable property is that it causes a temporary rise in blood pressure. Even the smallest doses, as solutions of 1 in 100,000, are able to affect the vascular system. Besides stimulating the heart, this drug produces contraction of the arteries and capillaries, especially when injected locally. Pal, for instance, found that, following the hypodermic injection of adrenalin, the quills of the porcupine or the hair of the cat are erected. In large doses, this agent is extremely toxic, and produces death by paralysis. Its main importance for us lies in the fact that, when injected hypodermically, it produces contraction of the numerous vessels within the field of injection. The absorption of the anesthetic is, therefore, greatly retarded, the full effect of the anesthetic localized and satisfactory anesthesia assured. This delayed absorption also diminishes considerably the toxic effect of anesthetics upon the system. Thus as we see, adrenalin produces a number of important phenomena to which, as Braun justly remarks, we owe the final realization and the remarkable progress of local anesthesia.

No wonder then, that, as the development of local anesthesia advanced, the brilliant star of general anesthesia began to fade. General anesthesia, in fact, is now employed by dentists only in rare cases of uncertain origin and of difficult access, to the great advantage of suffering humanity.

There is hardly any specialty in which local anesthesia can be employed as generally and as well as in dentistry, where minor but extremely painful operations continually occur. General anesthesia, no matter by what agent, still involves a certain risk for the patient's life. Thus it has been calculated that, even from carefully managed mixed anesthesias one death occurs in 7,558 cases, and in chloroform anesthesias, one death in 2,853 cases. In 6,013 ether anesthesias one death occurs, according to statistics. Operations performed under local anesthesia, on the other hand, are no longer to be regarded as dangerous, provided the operator carries out all the necessary conditions. He must be familiar with the anesthetic agent employed, with the patient's condition, and all the details of the case, and he must be full master of the technique of local anesthesia. Even in extremely sensitive patients, local anesthesia enables us to make careful and thorough operations extending to sound tissue, without any sensation of pain, to work rapidly, and to be independent of accidents that may arise from the patient's excitement or the action of the narcotic. The anesthesia obtained is profound and reliable, so that, even in difficult cases, satisfactory results are obtained without bad after-effects, which so frequently follow general anesthesia.

What, then, are the means by which such favorable results can be obtained? Cocain, as you know, was the first effective local anesthetic known. It is still being used, especially in cases where its toxic properties cannot exert themselves, as, for instance, for superficial anesthetization of the mucous membranes, etc. Cocain is, first of all, a pronounced protoplasmic poison. Moreover, it is always detrimental to the nerves, the kidneys, and the heart, and is, therefore, contra-indicated in diseases of these organs. One fact in connection with cocain must never be lost sight of—namely, that cocain, even in the very highest dilutions, may produce death, though, on the other hand, very large doses are known to have been tolerated with impunity. The toxicity of cocain, therefore, is an uncertain factor which cannot be known beforehand, and involves a grave risk for the health or even the life of the patient in every case.

All these arguments surely justify the efforts to discover substitutes for this highly toxic drug. Of the numerous substitutes offered, Novocain most perfectly fulfills the requirements of an ideal local anesthetic. These requirements are as follows: First, while equally potent, it must be less toxic than cocain. Second, it must not damage the tissues, and must be absorbed without causing irritation. Third, it must be soluble in water, and must allow of easy sterilization. Fourth, it must allow of combination with suprarenal preparations.

These requirements have, so far, been best fulfilled by Novocain.

Novocain is a salt, which is easily soluble in water, and can be sterilized by boiling any number of times without detriment. Without the addition of suprarenin, novocain is an effective, but volatile anesthetic, with a power lower than that of cocain. As soon as suprarenin is added to novocain solution, the action of this drug is at once intensified. The combination of these two salts develops a great anesthetizing power of deep penetration, which even seems to surpass that of the much more toxic cocain. This intense and prolonged effect, together with its low degree of toxicity, renders novocain-suprarenin solution extremely valuable. Novocain is precipitated and rendered useless by alkalies. For this reason it is necessary to clean and sterilize all instruments that come in contact with the solution, in boiling distilled water. Novocain solutions are seven times less toxic than those of cocain, though equally powerful, and can be repeatedly sterilized by boiling. Large doses of 1 per cent. or 1½ per cent. solutions can be employed without fear of untoward sequelæ. In major surgery cases have been reported in which more than 200 cc. of a 1 per cent. solution with suprarenin admixture were tolerated perfectly well. Pure novocain in powder form may be even applied to wounds or mucous membranes without causing intoxication. Novocain, in the words of Braun, is "an ideal anesthetic which not only can be employed instead of cocain, in every case, but which has materially increased the safety of local anesthesia, because much larger quantities of this effective anesthetic can be injected freely." Moreover, the addition of suprarenal extract consid-

erably increases the effect and reliability of novocain without altering the relatively very low toxicity of the solution.

In themselves, all suprarenal preparations are highly toxic agents of tremendous power. For this reason they are used in very high dilutions only, generally 1 to 1,000. Only a few drops of these solutions are added to large quantities of injecting solutions, as a rule one drop of a 1 in 1,000 solution to 1 cc. of novocain solution, so that the quantity of suprarenin used represents the very low concentration of about 1 in 100,000. Nevertheless, we observe, almost immediately upon injection, an increase in heart action, acceleration of the pulse, and, if large doses are administered to weak patients, especially those with heart trouble, we observe dizziness and fainting spells which, however, quickly pass off. In dentistry such cases are very rare, since, as a rule, never more than about 20 cc. of a 2 per cent., or 40 cc. of a 1.5 per cent. solution are employed at one sitting; this quantity is small compared with the doses frequently called for in major surgery.

Unlike pure novocain solution, the $^1/_{1000}$ per cent. suprarenin solution, if once made, is extremely unstable. Light, air and temperature at once start its decomposition. The originally water-clear fluid begins to change to a yellowish and later a reddish color. Decomposed suprarenin is even more highly toxic, and produces additionally undesirable effects by retarding or impeding the rapid absorption of the injected solution, as evinced by swelling. Large doses of decomposed suprarenal extract may even cause death.

These bad effects disappear at once, or are reduced to harmlessness, if the drug, instead of aqueous solution, is used in tablet form; and if, instead of organic preparations, synthetically prepared suprarenal extract, that is suprarenin, is employed. Synthetic suprarenin is more stable than the organic preparation, and at the same time less toxic, without having lost any of its desirable properties. In dry or tablet form, synthetic suprarenin will keep for a very long, perhaps indefinite, period of time; in solution it is very unstable. Novocain-suprarenin tablets have now been perfected to such a degree that we have at

our disposal an easy, quick and reliable method of preparing a fresh, sterile solution before the patient's eyes.

The quality of the solution does not, however, depend upon novocain and suprarenin alone; a number of other factors must be considered, in order to bring about as final result an isotonic solution capable of being absorbed. We can use only a solution which by its chemical composition is physiologically perfect, which will pass through the tissue cells without creating damage, and which will be excreted without causing any reaction. Hence, only such liquids are suitable which approximate the osmotic pressure, or freezing point of the fluids of the human tissues. Since the local anesthetics to be injected into the tissues are used in a concentration far below their physiological state, the distending and destructive action of their solutions upon the tissues must be counteracted by the addition of a suitable quantity of such salts as go to make up the cells, as, for instance, sodium chlorid. If pure water is injected under the skin, disturbances arise in the cells and tissues of the injected area. Water, as we know, possesses the properties of a protoplasmic poison, and destroys the structure of the cells. If, however, a suitable quantity of sodium chlorid is added to water, its untoward action is greatly restrained or abolished, provided the injection solution contains, besides sodium chlorid, other salts which go to constitute the physiological composition of protoplasm and the tissue fluids, such as calcium chlorid and potassium chlorid. Calcium especially plays an important part. A trace of calcium suffices to increase the vital function of the leucocytes, the salts of calcium being of prime importance in phagocytosis and in resistance to infectious diseases. The remarkable superiority of a solution of calcium salts over sodium chlorid solution is evinced by the following experiments:

If the excised heart of a turtle, which in a moist medium continues to beat for a long time, is immersed in a pure sodium chlorid solution, the beats cease immediately. Sodium chlorid, therefore, evidently exerts a toxic action upon the heart. If, however, a minute trace of calcium is added to the solution, the heart commences to beat again.

If a trace of calcium is added to a sodium chlorid infusion

in heart collapse, the human heart begins almost at once to work more vigorously, and the blood pressure rises higher than it would if a sodium chlorid infusion simply were used.

Calcium therapy also plays an important role in infectious diseases, since calcium, if added to a vaccine, has a stimulating action upon the functions of the heart and the leucocytes.

In line with these findings, the Viennese scientists, Chiari and Januschke, have ascertained that soluble neutral calcium salts exert a surprisingly pronounced antipyretic action. According to Leo, it seems certain that the calcium salts in the human body serve as solidifying agents, and that their presence is indispensable, especially in the enzymotic processes leading to the coagulation of fibrin and casein. The action of the calcium salts is not directed against the pyrogenic agents themselves, but they serve to strengthen the resistance of the tissues against the influence of pyrogenic agents without influencing these directly. In inflammations of the mucous membrane of the mouth, for instance, Leo recommends rinsing with 2 per cent. calcium solution.

In my experience, the addition of calcium chlorid to the injection solution has given so much satisfaction that I would not care to return to pure sodium chlorid solution. The calcium salts that I have used continuously for one year and a half in the so-called Ringer solution, in combination with potassium and sodium chlorid, have a most favorable influence upon the absorption of the anesthetic, even in complicated cases; they increase its penetrating power, and materially contribute to rapid and safe healing. In all cases of difficult absorption, where formerly edema and after-pain used to occur, untoward secondary effects have been reduced to a minimum, or have been done away with by the use of the solution of sodium and calcium chlorid. Following simple injections, no disagreeable sequelæ of any kind are ever observed.

From the foregoing, the following composition of the injecting solution can be recommended as being the best:

℞	Novocain	1.0 to 2.0
	Sodium chlorid	0.5
	Calcium chlorid	0.04
	Potassium chlorid	0.02
	Aqua distillata	100.0
	Synthetic suprarenin (1 in 1,000)	0.002

Of the constituents which make up this solution, novocain and suprarenin, in form of the special tablets E or G, are kept in stock, while the other salts, which are combined in the so-called Ringer tablet are used for making the dissolving medium. This Ringer solution is difficult to preserve for any length of time in a stock bottle in such a way that, despite the frequent use of small quantities, it remains sterile to the last drop. Ordinary bottles are useless, because every time the bottle is opened, and some solution is poured out, bacteria are introduced into the solution, and rapidly increase in this most favorable medium. For this reason I have indicated a stock bottle of Jena glass, which is lacking in alkali. This bottle permits of the gradual consumption of the Ringer solution. The injecting solution is made in the following manner:

In the small stock bottle, five so-called Ringer tablets are dissolved in 50 cc. of sterile distilled water. The bottle is closed, the side-opening closed with cotton, and the contents are boiled for ten minutes in a water bath. After cooling, the sterilized Ringer solution is ready for use. From the stock bottle, the desired amount in cubic centimeters of Ringer solution is poured into a small porcelain cup. If 3 cc. of injecting solution are desired, slightly more than 3 cc. of Ringer solution are poured into the cup, the liquid is brought to boiling point over an alcohol flame, and in this solution one tablet of novocain-suprarenin per each cubic centimeter of solution is dropped, that is to say, in our case, three tablets. The solution is once more boiled for a moment, and drawn into the syringe which has been sterilized in the meantime. The resulting solution is as clear as water, and is immediately injected, while it is still warm. The syringe is best mounted with an iridio-platinum needle. A short needle of 23 mm. length is employed for mucous anesthesia, a long one of 42 mm. length for conductive anesthesia. The short points of these needles must always be kept sharp. The needle, when mounted on the syringe, is not detached after the injection, but remains permanently mounted as long as it is sharp and straight. After every use, boiling water is drawn into the syringe several times, the needle is heated to a glow, any water that may have remained in the syringe barrel is ejected, and the clean syringe

is suspended in an alcohol-glycerin jar, containing a mixture of three parts of alcohol and one part of glycerin, chemically pure, and is kept there until removed for use.

Before the solution is drawn into the syringe, and before an injection is made, the needle is heated to a glow in a flame, thus making sure that, when being introduced into the tissues, it will be as perfectly sterile as the freshly prepared and boiled solution.

Another important point remains in order to insure perfect success of the injection. The point of insertion of the needle into the mucosa must be as clean and free from bacteria as possible. This is best done by painting the area with dilute iodin solution. Then the needle is at once inserted into the mucosa.

An injection which has been made under all these precautions must be regarded as perfect. The injected solution is ideally adapted to the tissue fluids; in other words, it is isotonic. Since it is injected at body temperature, it cannot harm the tissues in that way. Owing to the optimum concentration of novocain, which is 2 per cent., all sensibility of the tissues is abolished for a considerable length of time without any untoward sequelæ whatever, and, owing to the action of the suprarenin, an increased vascular activity, viz., hypermia, sets in and subsequently carries out the process of absorption. The insensibility of the anesthetized area gradually decreases, normal sensibility is re-established, and the anesthesia disappears without any unpleasant after-effects. Any after-pain noted is to be attributed to surgical trauma. Swelling and edema are not concomitants of local anesthesia, but are due to infection of some kind. The oral mucosa is very difficult to sterilize; the virulence of the various mouth bacteria is extremely variable, as is the behavior of the tissues in different individuals toward injected solutions. Thus we note remarkable differences in local anesthesia, which are to be attributed ultimately to peculiarities in various individuals. For this reason it is all the more advantageous that, of all anesthetic solutions and agents, none is as constant and prompt in its effects as novocain-suprarenin solution, which I hope to have the pleasure of demonstrating to you in a number of cases.

The success of novocain-suprarenin anesthesia is best

evinced by the fact that it is crowding general anesthesia into the background in major surgery. In many German hospitals, operations, which a few years ago used to be performed under general anesthesia exclusively, are now being done under local anesthesia. Braun, of Zwickau, one of the foremost champions in this field, employs local anesthesia exclusively for the following operations: All operations of the face and maxillæ, resections, carcinomata in the floor of the mouth, cranial resections, strumectomies, tracheotomies, resections of ribs, gastrotomies and numerous other operations. A few statistical data may illustrate this progress in local anesthesia:

Year of	Number of operations.	Anesthesias. General.	Local.
Heidelberg Surgical Clinics			
1906	1917	1633	218
1907	1936	1377	426
1908	2070	1460	559
1910	2303	1583	632
Zwickau Free Hospital			
1908	1529	1078	375
1909	1542	995	489
1910	1811	1029	727

It is hardly possible to fix the maximal dose of novocain-suprarenin solution, as its toxicity depends as much upon the concentration as upon the technique of application, and dosage of the solution. Usually from 0.5 to 2 per cent. solutions are employed in combination with suprarenin. Of the 1 per cent. solution, up to 200 cc. have been injected without any untoward sequelæ, and even of a 1½ per cent. solution, Hesse and Braun have injected 200 cc. with impunity. The greater the concentration of the drug, the smaller the quantity to be injected. Of a 2 per cent. solution, the maximal quantity of a 20 cc. should not be exceeded.

The healing process is not unfavorably influenced by local anesthesia either in general surgery or in dentistry, so that, taking it all in all, novocain-suprarenin solution is one of the most valuable assets of our special science in all its branches.

In oral surgery, above all, local anesthesia is pre-eminently indicated, general anesthesia being restricted to a few cases which, for reasons of technique, are unsuitable for injection, such as cases of ankylosis or advanced phlegmon.

Conservative dentistry offers another broad field of application to local anesthesia, especially in overcoming the often intolerable hyper-sensitivity of the dentin. All agents which are claimed to obtund such dentin by local application, are unreliable. So far, no safe and powerfully penetrating dentinal anesthetic has been found, which, while being harmless to the pulp, would permit of finishing the preparation of a cavity in one sitting. There is no dentinal anesthetic which will produce anesthesia of the pulp as certainly, rapidly, and without danger for the pulp as injection. I have personally made an endless number of observations and experiments with the preparations offered in the market, and I have arrived at the conclusion that anesthesia by injection offers the safest and most expedient guarantee for the elimination of pain from hypersensitive dentin. To be sure, before inducing anesthesia, the condition of the vitality of the pulp must be carefully determined since the action of the anesthetic eliminates all the important diagnostic symptoms of pulp vitality. There is no response to temperature and mechanical stimuli, and the blanched pulp tissue is difficult to recognize.

If desired, the patient's sensibility may be reduced by the internal administration of morphin, chloral hydrate or quinin from one to two hours previous to operation. A very serviceable formula for this purpose is the following:

℞	Morphin	0.2
	Hyoscin	0.005
	Aqua distillata	10.0
S.	From 6 to 8 drops to 1 tablespoonful of water.	

Anesthesia by injection is ideal, for abolishing the excruciating pain from pulpitis or pericementitis. Following injection, inflamed pulps can be exposed painlessly and dressed with arsenous acid, or can be extirpated immediately, as is advisable in pressing cases. Teeth affected with acute pericementitis, which are extremely painful upon the slightest touch, can be opened with perfect leisure.

In crown and bridge work, novocain has been adopted in from 30 to 40 per cent. solution for avoiding pain in the gums in preparing abutments.

A word should be said about the use of novocain-suprarenin

in patients with serious constitutional diseases. The 1.5 per cent. solution can be employed in arteriosclerotics, diabetics, nephritics, cardiacs and the tuberculous, without hesitation. If desirable, the dose is reduced, and there is no risk for the patient's life or health. In such cases the use of cocain would be impossible, since cocain involves a direct danger for the life of all such patients.

It seems fitting to point out that hysteria patients require special care regarding local anesthesia. Any anesthetic, even novocain, when administered to a hysterical patient, may under certain conditions, elicit serious hysterical attacks, hallucinations, especially of a sexual nature, so that the presence of a third person is imperative even in local anesthesia. The effect of the anesthetic in hysterics sometimes differs from the normal; in some such cases, the anesthetic seems to fail, in others its action is imperfect, and, again, it may bring about narcotic conditions which may not disappear for several hours. In all such cases, we probably have to deal with more or less pronounced hysterical phenomena, which counteract the action of the anesthetic. There is no doubt, however, that these failures are only apparent ones, since in the cases which I have observed. the anesthesia was fully established, despite the patient's misleading gestures and complaints.

As I have indicated before, pure novocain can be introduced directly into wounds without risk of subsequent damage to the tissues. For the prevention of after-pain following complicated surgical operations, this fact is of the greatest significance. In painful extraction, wounds, etc., nothing will bring about such a rapid and safe painless healing as a pure novocain tampon. After the emptied alveolus has been carefully cleansed and curretted, from 0.5 to 1 gram of pure novocain is introduced into the fundus of the wounds, and over it, a light gauze tampon is laid for one or two days. Pain is abolished almost immediately without returning, and the wound heals rapidly and without complications under the influence of the anesthetic. Cocain could never be employed in this manner, as it would produce such a strongly toxic effect that the patient's condition would be most seriously jeopardized.

A suitable instrumentarium is not without importance for the success of local anesthesia. The syringe must allow of sterilization and of continual control of the condition of the injection solution. For these reasons only combination glass-and-metal syringes can be recommended as fulfilling all requirements. The syringe made by a German firm upon my suggestion seems very practical for our purpose. It is built strongly, because in mucous anesthesia we often have to apply considerable pressure. It can be taken apart entirely, and can be sterilized any number of times. If carefully preserved in alcohol and glycerin after each use, it will remain sterile for a long time.

After sterilization by boiling, the syringe is mounted with the hub B and the short iridio-platinum needle for mucous anesthesia of any kind. For conductive anesthesia, a second syringe is kept in readiness, holding 2 cc., with the hub C and the iridio-platinum needle of 42 mm. length. These syringes, as has been said before, are kept in a spacious glass jar, half filled with alcohol and glycerin. A metal stand in the jar supports the syringes in such a way that the needles are deeply immersed in the liquid.

Before using, the syringe is removed from the glass jar, and hot distilled water is drawn through it, in order to wash out any glycerin and alcohol. The iridio-platinum needle is glowed in a flame, and the freshly made solution is drawn up into the syringe. Steel needles cannot be recommended, as there is danger of their rusting. They break easily, and are positively dangerous in conductive anesthesia of the mandible. The finding and removing of a steel needle that has been broken in the mandibular sulcus is one of the most difficult and uncertain surgical operations. Cases have been reported in which broken needles, after vain efforts at surgical removal, have produced death. If the needle has not been sterile, it may easily produce sepsis, and, if it was sterile, it may remain encysted for years, until it begins to migrate and produces a serious disturbance in the functions of the muscles of mastication. But who can guarantee absolutely that a needle is sterile, unless he is able to glow it, after mounting it upon the syringe? This is the great advantage of the iridio-platinum needle. It can be glowed an

indefinite number of times, it does not break easily, but bends. This minor disadvantage is soon overcome by practice. An iridio-platinum needle can remain in use for months, after having been mounted upon the syringe, even if strenuously used, while a steel needle should be used only once, owing to the danger of rusting.

I have so far familiarized you with the various difficulties and conditions with which we have to cope, theoretically, in local anesthesia.

We shall now say a few words regarding the technique proper, which, as a rule, offers the greatest difficulties for the beginner. I shall, however, not tire you with an elaborate description of the anatomy of the jaws, and the various points for the insertion of the hypodermic needle. I may, however, be permitted to describe the technique of injection in the barest outlines. We can distinguish between maxilla and mandible, inasmuch as the mandible is the proper field for conductive anesthesia, while mucous anesthesia is applicable chiefly in the maxilla. Conductive anesthesia in the maxilla is limited to cases where injection near the tooth is contra-indicated, as in abscess. In such cases, we locate the different trunks of the superior dental nerve at the maxillary tuberosity, and the infra-orbital nerve above the canine fossa. While in conductive anesthesia, we always inject into loose connective tissue, we have to infiltrate the taut mucosa and the periosteum in all mucous injections. The needle is inserted carefully and slowly in a horizontal direction, half-way between the cervical margin and the root apex of the tooth; a few drops of the anesthetic are injected immediately, and the needle is then slowly and gradually advanced under the periosteum in the direction toward the root apex of the tooth to be anesthetized. The mucosa gradually becomes anemic, and, owing to the pressure of the injected solution, a wheel may be formed. If the injection has been made slowly and under pressure, the solution penetrates through the minute foramina in the bone into the interior of the alveolar process, so that finally the entire tooth is surrounded with the anesthetic solution. After the injection is completed, the point of insertion is immediately compressed, and the injected area massaged for

a short time. Palatally, we inject only a small quantity—that is, about one-eighth of the amount injected buccally. In all mucous anesthesias, complete loss of sensibility ensues within from eight to ten minutes. In children, owing to more rapid metabolism, the effect is more rapid than in older persons, who sometimes require a little patience.

In the mandible, mucous anesthesia, as a rule, is not sufficiently certain, since the diffusion of the liquid is impeded by the strong and thick cortical layer of bone. Mandibular anesthesia, however, is certain, and can be used in all cases over six years of age, and this form of anesthesia has met with the greatest success. It is, indeed, surprising to see how one side of the mandible, which is difficult to anesthetize otherwise, becomes insensible after a single injection, regardless of the patient's age. The time of waiting for the effect of conductive mandibular anesthesia is twenty minutes. Untoward sequelæ are not observed either from mucous or from conductive anesthesia, if executed correctly and under sterile conditions.

Time forbids to enter into a description of the technique of local anesthesia, the greatest difficulty of which consists in its description. A few lantern slides will show what words cannot demonstrate. A practical demonstration in patients, of course, is the most convincing evidence, because it allows of a direct study of the technique of injection and its effects, and carries with it the conviction that the method advocated by me is a successful one. Such demonstrations will show that novocain solution is a powerful and trustworthy weapon in combating pain in our operations. Novocain is an ideal anesthetic, without the many dangerous drawbacks inhering in cocain; it not only takes the place of cocain, but it enhances considerably the safety of local anesthesia, owing to the possibility of injecting large quantities of a most effective solution without any untoward sequelæ. The introduction of novocain-suprarenin was as important an event for local anesthesia, as was at one time the introduction of cocain in medical science.

I shall now take pleasure in showing you a number of lantern slides, which will illustrate the main items of the technique of injection.

[Slides and moving picture demonstration here introduced, followed by prolonged applause.]

In conclusion, allow me to thank you heartily for the great interest which you have taken in my paper. I am proud and happy over the privilege of speaking concerning my specialty before such a notable gathering of colleagues. My fond hope that my lectures and demonstrations may find fertile soil in this great country, and that local anesthesia may be generally adopted here, I know will be realized, unless I have made a fatal error in my judgment of the remarkable abilities and the world-wide reputation of American dentistry.

REPORT OF OPERATIONS PERFORMED BY DR. GUIDO FISCHER

The following is a report of operations performed by Dr. Guido Fischer, at the Oral Surgery Clinic of the New York College of Dentistry, under the auspices of the Oral Surgery Section of the First District Dental Society, S. N. Y., H. S. Dunning, M.D., D.D.S., Chairman.

Dr. Fischer performed these operations with great skill and deftness upon patients taken from the College Clinic. His anesthesia was complete in every case and his operative technic and surgical judgment were very fine. About forty-eight members of the First District Dental Society took Dr. Fischer's course of instruction, which consisted of the demonstration of the preparation of the Novocain and Ringer's solution, sterilization and care of the syringes and needles, preparation of field of operation, selection of cases for local anesthesia and finally the technic for the various injections.

A. *Operations performed under conductive anesthesia of the lower jaw.* (Mandibular injections.)

1. Removal of four severely impacted third molars.
2. Removal of five large epuli, involving 3-5 teeth each, which were extracted.
3. Curretage of extensive area of necrosis. Four cases.
4. Extirpation of pulps of single and multi-rooted teeth.
5. Excavation of ten sensitive cavities.
6. Extraction of sixty-five broken-down teeth and roots.
7. Reduction of fracture of lower jaw, region of second molar (mandibular and submucous injection).
8. Removal of abscessed third molar, incision into abscess, evacuation of pus.

B. *Conductive anesthesia of upper jaw.*

Tuberosity, canine fossae, infra-orbital, anterior palatine, posterior palatine injections.

1. Removal of tumor extending from the central incisor to the first molar.
2. Removal of sarcoma of upper jaw, right side, involving antrum.
3. Radical antrum operation for maxillary sinusititus.
4. Excision of several small growths, epuli, involving one or more teeth.
5. Curretage of large area of necrosis, from first molar to median line, involving antrum.
6. Excision and curretage of three large bone cysts, involving 2-4 teeth.
7. Curretage of necrotic areas. Eight cases.
8. Extraction of eighty-seven broken-down teeth and roots.
9. Extirpation of five vital pulps.
10. Excavating sensitive cavities.

PROFESSIONAL STANDARDS AND PROFESSIONAL COURAGE: THEIR INTERRELATION AND THEIR PLACE IN DENTAL PRACTICE[1]

By Henry W. Gillett, D.M.D.

It is a truism that every individual, striving for success in any field of professional endeavor, will find it advantageous to set for himself early in his professional career, the general standards to which he aims to adhere. It seems to your essayist that it is equally self-evident that frequent consideration of one's relations to those general standards, and a careful review of the situation with reference to their possible changing values, should be considered equally advantageous and important.

If these two postulates be accepted, then it must needs follow that it is of the highest importance to each member of any profession that there be mutual consideration and conference among its members as to what are its standards, and how they are influenced by advancing knowledge in its own chosen field of activity, and in those of kindred professions.

The importance of the consideration of advancing and changing standards, increases in a ratio proportionate to the youth of the profession under consideration. In the case of the younger professions, there are more new fields to explore, and more new contacts to be made with allied professions, than in those where exploration and research have been active for longer periods.

As one of the youngest of the professions, our own calling is conspicuous as an example of this condition. For several generations our knowledge has been advancing rapidly, in spite of the fact that reliable research work has been limited in amount, sporadic in character, and the records of that which has been done frequently not so chronicled as to make them available to those whom they most concern. Much of our advance has been along empirical lines, with only imperfect clinical evidence and observation to give warrant for the adoption of the promulgated theories. Obviously we have advanced in spite of this, as is to be expected in so young a profession—advanced so

[1] Read before the Harvard Odontological Society, Boston, Feb. 28, 1914

rapidly as to make it easily possible to imagine that the well-equipped practitioner of any period, if suddenly translated to a period ten years later, would be entirely lost if supplied only with the armamentarium of the advanced practitioner of that later period.

You will notice that I have so far used the term " advance " for these changing conditions. In my opinion, it will always be true when change is based largely on empiricism, and that very unreliable source of information—clinical evidence as interpreted by the clinician and the patient—that some portion of the so-called advance will be found to be only change, or an unbalanced advance, in which the sense of proportion has been lost. To those of you who have been thinking clearly and noting the trend of research investigation, it is only needful to cite the havoc we, as a profession, have wrought with our fixed bridge-work for the past two decades, and which undoubtedly will continue for another decade, because of the lethargy of our profession in some lines of thought and action. As a profession, we were unduly elated with the mechanical possibilities and achievements open to us. Many of us were blinded by these mechanical achievements and failed to retain our sense of proportion—failed to investigate sufficiently the results of our labors; were too often content with successful mechanical technique in dealing with the individual elements of the organ under our care, and too often overlooked the relations of that element to the whole organ.

My remarks thus far may be considered in the nature of a preface to the general line of thought I wish to present for your consideration. I have mentioned in this preface but a single line of our work in which we have become subject to criticism. Before going on, I want to call up in your mind pictures of certain conditions as we see them from day to day in the mouths of those applying to us for service—pictures of conditions that should never be possible—pictures of conditions that stamp either our standards and our skill as faulty, or our persistency and courage in living up to them as weak.

I refer to the constant succession of cases in which the work done by the dentist is responsible for foci of infection in the

oral cavity, and which are permitted to remain as probable chronic sources of disease.

For generations, dentists have preached the need for mechanical excellence in our work, but in practice we find too few instances of sturdy adherence to those principles, and too many instances of chronic failure to observe the principles preached. Please bear in mind that I am talking about us—you and me—about the men who make up the instruction corps of our colleges; the men who occupy places on our boards of examiners; the men whom we find among the officers and constant attendants of our society meetings; and not about the advertising quack or the alleged ethical dentist, who is avowedly only interested in " what there is in it " for him financially.

We all know that many patients of some of these men are going about with chronic foci of infection, due to crown bands that never fitted; to bridge work so constructed that no one can keep it clean; to fillings of all kinds, with projecting cervical portions that insure constant infection foci; with fillings and inlays that lack proximal contact, and so foster congestion and disease in soft tissues, with ineffective plastic substitutes for lost tissue; with chronic fistulae and blind abscesses, and chronic pyorrhea pockets for which nothing is done; and with teeth that have been retained with the operator's advice or assent long after they menace the health of the subject, and that of those around him.

Now, gentlemen, these are plain words, and a drastic indictment of the standards practised by many men who know better —they will rouse objection from many of you, but I challenge you to dispute them.

I have drawn the indictment because I am convinced that it is necessary, if our profession is not to be overwhelmed with criticism from without its ranks, that we take account of stock, examine our standards, analyze their status, and find and apply the remedy for the conditions I have enumerated.

Knowledge of dental art and practice had reached a point, about a year ago, which inspired one of the most noted surgeons in the world, and one of the most noted research men in the medical world, to make statements with earnestness and

conviction before dental organizations which may be summed up in the much-quoted phrase of Dr. Charles H. Mayo—namely: "It is evident that the next great step in medical progress in the line of preventive medicine should be made by the dentists. The question is, will they do it?" Such statements from the leaders of the medical world should stimulate us to inspect carefully our standards of practice, and to search diligently for the means available for grasping the opportunity presented to us.

As was well said by Dr. E. C. Kirk in an editorial last April, "in Dr. Mayo's appended inquiry, 'Will they do it?' we have the implied recognition of the equivalent responsibility which this great opportunity involves."

I believe that responsibility has not yet been brought home to us as a profession with sufficient force.

If it had been, we should be flocking to the standard of The National Dental Association Research Commission with our funds and our proffers of assistance; we should be burning with impatience for final and complete confirmation or refutation of the postulates that those foci of infection, that I have enumerated as common in mouths under our professional care, are responsible for a material percentage of the endocarditis, the gastritis and the gastric ulcers, the milder joint lesions, and the distressing rheumatoid arthritis cases, some of the acute Bright's disease, and much of the neurasthenia.

Responsibility for all these, and more, is being laid at our door by competent research workers and medical men.

What are we to do about it? What we *should* do is first to clean house individually—see to it that professional standards are so defined in our own offices that no one of the things recognized as conducive to the establishment of infection foci in the mouths of our patients shall happen there. This involves critical inspection of all of our own work, and, if we find that our crown bands project and cause chronic gum irritation, that our amalgam fillings, our gold fillings, our inlays or our fillings of any type, upon searching examination, present projecting margins or lack proximal contact, then it is essential that we improve our methods. We must not be content merely to do our best, if our best involves stopping short of attaining the result

aimed at. We must find the ways and means of learning how to do better; we must find the man who *does* know how, and gain from him the necessary knowledge. We must use the means that science has provided for diagnosing with accuracy and for testing our results. Diagnosis is a weak point with us, and one that needs serious and earnest attention. With the average mutilated organ presented for our service, it is no more possible for the general practitioner to formulate a well-balanced plan for work that shall promote efficiency of function in that organ without accurate plaster models, than it is for the orthodontist to do so in an orthodontic case.

We owe much to the orthodontists, and not the least of our debts is the standardizing of our knowledge as to how to diagnose occlusal conditions. I believe it frequently happens that thoroughly well made restorations, from the standpoint of mechanical detail, at the hands of men striving earnestly to render efficient service, do more injury to the patient by locking the occlusion than can be compensated for by any added value from the increased surface provided for crushing food.

We should know in advance of root canal work what type of root we are dealing with, whether there is already an infected area at its tip before we begin; and, above all, we should know whether at the end of our labors it has been filled to the apex. This is all feasible with the present development of radiographic apparatus; and it is my belief that X-ray apparatus is more important to the dentist as a part of his office equipment than it is to the practitioner of most other branches of the healing art. With it we can distinguish in advance many of the cases of pyorrhea too far advanced for effective treatment, and solve many problems in each day's work. No dentist is warranted in assuming that a pulpless tooth is healthy because there is no visible disturbance or soreness. If such a tooth, with unknown history, needs attention, a radiograph should be the first step in the diagnosis.

Neither is a dentist warranted in assuming that his root fillings have reached the apex, and filled the root canal unless a radiograph confirms the assumption. If serious trouble occurs about such a tooth in its later history, the dentist is liable to be

confronted with the very embarrassing question—"Why did you not use the means provided by science to know whether your work had been effectively done?" The dentist who uses non-sterile instruments in a root canal, who touches them with his fingers during the progress of the work without resterilizing before they enter the canal, or the one who winds cotton dressings on a broach with his fingers, and uses it for drying a canal or to leave as dressings, is comparable to the surgeon who fingers a laparotomy wound with septic fingers. Death may be less certain, less prompt and less spectacular as a result, but chronic invalidism and possible death from some secondary infection, are lurking behind just such careless acts of the dentist.

We should know the type of infection in pyorrhea, and more especially in infected root end areas, and know whether it has been brought under control before we complete our labors. This is possible by working in touch with competent bacteriological laboratories.

Such laboratories will supply culture media in a form permitting ready transmission of the cultures from infected or suspected areas to them for examination. The streptococcus viridans, which is just now receiving so much attention from the medical profession, is apparently found in a large proportion of the chronic and blind abscess areas about teeth, and in many of the pyorrheal infections. In view of the information now, or about to become, available to us, it seems probable that we may fairly be held responsible if we fail to warn the medical adviser of any patient of the character of the infection in any purulent discharge coming under our notice in the field of our labors.

Some case histories presented by Dr. T. B. Hartzell, at a recent meeting of the First District Dental Society of New York,[2] will be well worth your study in this connection. To stimulate your interest, I will quote here the rough outline of a case history that recently came to my knowledge from a reliable source. A male patient in an advanced stage of joint disease, so incapacitated as to be able to take only six-inch steps as a maximum, showed, upon examination, the presence of advanced

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[2] See Dr. Hartzell's paper at p. 166 of the June number of THE JOURNAL.

pyorrhea and a supposed chronic gonorrhea. Cultures from both discharges were made, resulting in a finding of streptococcus viridans in each, and absence of gonococci in the supposed gonorrheal discharge. Cleaning the mouth, and vaccine treatment from cultures made from it, was followed by cure of the supposed gonorrhea and of the joint disease. Dr. Hartzell has numerous cases that are comparable to this one I have just read to you.

All these things mean not only research work for us, for which we must pay, but they mean need for an awakening on our part to the importance of post-graduate work in our ranks—real post-graduate work that shall involve definite instruction of how to do, and mutual criticism of what has been done. It involves more candor in our consideration of our own results and the results of others, and more readiness to accept candid and earnest criticism from each other concerning methods and results.

It means that we can no longer be content with the results that satisfy the patient, but leave cause for lesions very much more serious in their menace to his life and health than those for which he has consulted us. It means that the man who fails to urge and insist that every pus focus in the organ under his care must be eliminated in some way, exposes himself to the likelihood of being responsible for serious and even fatal secondary infections.

The medical man is awakening to these conditions, he is learning to look for pus foci in the mouth, to radiograph teeth, and identify infection areas about their roots; to read in such radiographs the story of half-filled or unfilled root canals, of active pyorrhea and incompetent dentistry; and the dentist who reports a patient as in sound oral health while discharging pus pockets and while other infected areas exist in the mouth, is likely to be stamped as incompetent, regardless of his financial success or the quality of his clientele. If the awakening of the slipshod can only come in this way, then let us hasten the day; but I am hopeful that we may within our own ranks, and by our own efforts, awaken the men who apparently have no standards to their need for later knowledge and better skill.

Where does professional courage fit in with this line of thought?

In my opinion, much of the laxness manifest in our profession, in the maintenance of perfectly well-known standards, is due to lack of courage in standing manfully to our guns in our every-day intercourse with our patients.

It is a characteristic feature of humanity to want to get off easily when we go to the dentist. We want our time conserved, our pains minimized, and our pocketbooks shielded. It is a great deal easier to yield to this demand upon the part of our clientele, and to be content with the simpler measures that will keep them from being conscious of *local* discomfort, than it is to insist that the right things shall be done, and done in the right way. It takes courage to let a patient go elsewhere because you will not do the thing you know is not the right thing, or which falls short of the procedure that will give him competent help, when you know equally well that the man in the next block, or perhaps across the hall, will cheerfully do it for him as *he* (the patient) wants it done, and foster his idea that you are over-particular, or are trying to foist upon him unnecessary work.

Right here is one of our sore spots, for which I confess inability to see a remedy. We have been taught, with good reason, loyalty to our professional brothers. It is unthinkable that we pursue any course that means general criticism to our clients of the work of others—anything tending to depress in their eyes the standing of one dentist lowers the standing of the profession; and the recriminations and enmities engendered would far outweigh any good that can come from such a course. We have all heard stories of the bitter enmities between the men of earlier generations of our profession; and no one of us would think for a moment of bringing back the days of drastic and open criticism of the methods and results of our confreres; and yet we need some way of forcing home to the unconscious practitioner of slipshod dentistry the fact that he is doing more harm than good in the world.

In conclusion, I can assure the young man who holds true under present conditions to the precepts I have advocated, that

he will have some heartaches over the issue; but to know as the years go on that he has preserved his self-respect, and has kept continuously to the front the professional man's first duty—namely, to advise and to work for his client's highest welfare to the exclusion of self-interest, is the reward to be won; and I believe it a reward worth the effort it costs to obtain it.

The future of the dental profession is to be a brilliant one; the laggards and the incompetents cannot stop its progress, but they will retard it. My message is largely to the young men—I ask of you that you be keen followers of the path of progress, and that you do your utmost to eliminate the drones and to uphold right ideals.

DENTAL CLINICS FOR SCHOOL CHILDREN

A DEFINITE PROGRAM FOR NEW YORK CITY IN 1915

By Edward F. Brown

SUPERINTENDENT, BUREAU OF WELFARE OF SCHOOL CHILDREN, NEW YORK ASSOCIATION FOR IMPROVING THE CONDITION OF THE POOR

I. INTRODUCTION AND SUMMARY

The intelligent interest awakened in the oral hygiene movement is amply manifested in the benevolent donation of Mrs. Elizabeth Milbank Anderson, who in providing for a Bureau[1] of Welfare of School Children in the Association[2] for Improving the Condition of the Poor, laid upon us the wise injunction to "attempt to increase the clinic facilities for the treatment of the physical defects of children, and particularly dental clinics, as it seems to be widely recognized that the school children not only suffer very generally from defective teeth but also that many of their ailments are due to that cause."

Following the astute advice of its founder, the Bureau immediately after its inception made a survey of the field in New York City to ascertain what the conditions were and what steps were desirable to meet the situation. Part of this preliminary effort was a study of the dental clinics maintained by the Bureau of Child Hygiene of the Health Department for the treatment of necessitous school children. Briefly stated, this study determined two cardinal points, namely:

1. That the Health Department had made a commendable beginning in the establishment of school children's dental clinics.
2. That there was urgent need for an extension of this work, after a carefully considered plan, in the interest of public health.

The Bureau, seeking to aid in a satisfactory solution of the problem, undertook the task of making a comprehensive plan for

[1] Bureau of Welfare of School Children: Willard D. Straight, chairman; Leonard P. Ayres, Leonard E. Opdycke, Chas. C. Burlingham, Owen R. Lovejoy, Philip Van Ingen, M.D., Thos. D. Wood, M.D., Miss Mabel H. Kittredge, the Author.

[2] A. I. C. P. officers: Cornelius N. Bliss, president; Robert Shaw Minturn, treasurer; Franklin B. Kirkbride, secretary; George W. Wickersham, counsel; Bailey B. Burritt, general director.

the establishment of clinics similar to those already in existence, apportioning the same in centrally located districts in which the need for such service was patent. The plan called for an ideal situation. Realizing that any profound change, to be enduring, must be slow and studied, the Bureau deemed it proper to divide the plan into a series of steps, each to be successively taken after careful consideration in a period of years. The first stage of our journey on the way to an effective and economic solution of the problem of caring for the teeth of school children is presented herewith as the program which we believe the city ought to make provision for in its budget for 1915. The plan and program have been developed largely in consultation with a special committee[3] of the First District Dental Society appointed for the purpose, under the inspiring initiative of Dr. Herbert L. Wheeler, its chairman. There were later added to this group other leading dentists, all of whom have generously aided in the formation and development of this plan.

1. *Dental Decay Among School Children.*—In 1913 the medical inspection of the Health Department found 194,207 cases of dental defects among school children. Owing to inadequate funds having been provided for this signally important work, the staff of medical inspectors is so limited that only 37.3 per cent. of the school enrollment were examined. If we assume the same ratio of defects in the unexamined 63.7 per cent. of the school population, there are apparently 524,359 cases of dental defects —major and minor—in the city schools, all, however, in need of immediate dental attention. This figure represents 59 per cent. of the school enrollment in need of such care. Without casting any aspersions on the work of the medical examiner, it is not unfair to say that even this is an underestimate, because the examinations were necessarily hurried, not made by dentists nor with the aid of a probe.

Of the 69.7 per cent. of the children found in need of medical

[3] Dr. Arthur H. Merritt.
Dr. Warrington Lewis.
Dr. Horace Gould.
Dr. Charles C. Linton.
Dr. C. Denny Kimball.
Dr. Donald B. Armstrong.
Dr. William C. Deane.
Dr. Matthew Carney.
Dr. H. Spitz.
Mr. Bailey B. Burritt.
The Author.

This list includes some dentists and laymen other than those of the official Committee.

aid, only 23.8 per cent. are reported treated for the defects discovered. A large number of the dental cases, estimated for the Borough of Manhattan alone at 81,512 children, are probably too poor to go to a private dentist. It is particularly to this group that we are to give attention.

2. *The Econony of Municipal Care.*—The unattended cases of dental defects and disease seriously affect the physical condition of the child, rendering it susceptible to other diseases through the general devitalization of the body. The community suffers in so far as it must harbor and ultimately in many cases must maintain dependents who may have been rendered unproductive because of the neglect of the oral cavity and the serious consequences which flow from such negligence. Educationally, the child is handicapped in not being in a physically fit condition to benefit by instruction. Economically, through the absences from school due to aching teeth, the child is frequently retarded in grades and the city must spend large sums of money in re-educating such children. Thus is the need apparent.

II. THE PRESENT STATUS OF DENTAL CLINICS

The school children's dental clinics maintained by the Department of Health were made possible by an appropriation allowed in 1913 by the city, so that the work of caring for the teeth of school children whose parents were unable to pay for proper dental treatment might be adequately attended. The Bureau of Child Hygiene, under the enlightened administration of Dr. S. Josephine Baker, recognized the need, as a result of which six clinics were organized with Dr. Matthew Carney as supervising dentist. The clinics were apportioned as follows: Manhattan 2; The Bronx 1; Brooklyn 3.

The following is the semi-annual report of the work performed in the Children's Dental Clinics of the Department of Health, for the period from January 1, 1914, up to July 1, 1914:

Number of patients	3,970
Number discharged	3,315
Normal	0
Cured	2,894
Dropped	461
Number of treatments	28,239
Number of temporary fillings	1,196

Number of operations	21,384
Deciduous extractions	7,802
Permanent extractions	405
Permanent fillings	10,644
Cleanings	2,092
Other	441

III. THE PRESENT SITUATION AND THE NEXT STEP

There are six dental clinics now maintained by the Bureau of Child Hygiene where children whose parents are too poor to pay for private treatment have their teeth repaired.

These clinics are apportioned as follows: Manhattan 2; The Bronx 1; Brooklyn 3; no provision whatever is made for Richmond or Queens.

There are nine dentists receiving $1200 per annum who work three hours a day, usually in the afternoon from two to five. There is one supervising dentist receiving $1500 per annum. The clinics are open during the school vacation also. The clinics are located outside school buildings, and considerable difficulty is sometimes experienced in having the children go from their class work outside the school building for treatment.

The table given below shows the present apportionment of clinics and the next column indicates the contemplated distribution of the nine additional clinics for which funds are asked from the municipal authorities for 1915:

Boroughs.	*Present number of clinics.*	*Number asked for.*
Manhattan	2	3
Bronx	1	2
Brooklyn	3	2
Richmond	0	1
Queens	0	1
	6 (9 dentists)	9 (9 dentists)

At the present time there are nine dentists employed in the six existing clinics and an equal number of nurses.

We ask for nine additional dentists and nurses.

If the nine additional clinics are established, there will be fifteen dental clinics for the free treatment of school children for the whole city of New York.

Six of these will be located outside school buildings and nine in school buildings.

IV. THE SCOPE OF THE DENTAL CLINIC

At the invitation of the Bureau of Welfare of School Children, a council was called, consisting of the special committee of the F. D. D. S., other leading dentists and the executive officers of the Bureau. To this council the author had submitted twelve fundamental propositions relating to the proposed plan of clinical extension. The absence of any material difference of opinion on the general propositions indicated the careful thought which had been given to the questionnaire which was sent to each member of the conference some time before the meeting. The pith of the principles laid down by this group of New York's leading dentists follows:

1. That it will support the modest request for nine additional dental clinics as outlined in the proposal of the Bureau.

2. That the dental clinics be established in school buildings.

3. That the clinics be open from 9 to 5, with two shifts of dentists, each working half time.

4. That the supervising dentist, for adequate compensatión, devote his entire time to the work.

5. That the clinics should extract, provide plastic fillings, and clean teeth only.

6. That the Bellevue equipment be utilized for the surgical work.

7. That the dentists be paid $1200 a year for half-time work.

8. That a system be devised whereby the work of the dentists be checked up to insure efficient treatment of each school child.

9. That the clinic concentrate its work on the children between six and eight years of age.

10. That the treatments be absolutely free.

11. That, while the two-chair clinic has advantages over the single-chair clinic, for the present it is wise to organize nine additional single-chair clinics and subsequently, if it be deemed wise, equip these nine stations with additional chairs.

12. That the school clinic provide tooth-brushes, mouth and tooth preparations at cost to school children.

V. THE COST

The actual money cost in taking the first step in the admirable program of the Health Department will approximate $18,900 for the first year for professional service alone. Adding equipment and supplies, the total cost will in all probability not exceed $27,000.

No progressive dentist, having at heart the highest ideals of his calling, can afford to neglect to take an aggressive attitude in support of such a program.

With 524,359 cases of dental defects among school children alone, the duty of the dental profession is clear. Two phases of prime importance command attention—namely, prevention through education; and cure.

The prophylactic dental movement is, fortunately, not confined to the prevention of the defects and diseases of the oral cavity, but, on the contrary, is a wise measure in the promotion of public health generally. There is no greater or nobler service to which the dental profession can dedicate itself.

The impetus which will come as a result of the establishment of the dental clinics proposed, will serve to emphasize to the adult public the need of conserving the teeth—all of which will ultimately inure to the benefit, not alone of society as a whole, but to the dental profession in particular.

VI. THE EFFECT OF DENTAL IMPAIRMENT

1. *Physical*

If dental defects resulted in a purely local abnormality, the general apathy of the public might be condoned. The serious character of the ailments which are a proximate cause of dental neglect cannot be over-emphasized. Some of these results may be here summarized. Unsound teeth are inefficient servants in the task which nature intended them for—the cutting and grinding of food. The poisonous incubation of pathogenic bacteria in the recesses of decaying molars exposes the food to contamination, frequently poisoning the same, and in such an impure state it goes to the stomach. The lack of proper mastication of food results frequently in indigestion and other troubles of the stomach. Mal-

nutrition is sometimes the result of the inability to secure the maximum nutrition of the food owing to its being rendered unfit and unassimilable, or, more often, not rendered fit by reason of imperfect teeth. A malnourished body is a magnet for disease. The power of resistance is at low ebb. It is not difficult for disease to gain a foothold and overcome the victim. Frequently facial neuralgias are the direct result of unsound teeth. It is believed also that the tooth socket infection in pyorrhea alveolaris is responsible for many disabling, general, systemic disturbances, described sympotomatically as rheumatism.

Dr. Petruschky-Danzig says: "Decayed teeth offer during childhood the chief passageway for the tuberculous bacillus; thence arise the so-called scrofulous lymph ducts on the neck. Ninety per cent. of the Berlin and eighty-five per cent. of the Danzig school children have been found affected by these swellings. The imminent danger of decaying teeth in early childhood is clearly shown from this."

2. *Social.*

It is trite, yet nevertheless sound, to say that all that seeks to improve the physical condition of children contributes to the general health of the community. If it is possible to render a dull pupil efficient through improving its physical condition, it would make it unnecessary to provide funds for the re-education of such children. A child who is a good student is likely to continue in school and go on to a higher education much more readily than the child who, disappointed and in despair, leaves school owing to a bad scholarship record, the only cause of which may be some physical discomfiture, defect or disease. The inefficiency which results from leaving school early in life frequently sends into the large army of intermittent, unskilled workers, children, who when they grow up, are without a trade and for whom society frequently must make provision in free clinics, hospitals and almshouses, and not infrequently in prisons.

If the scrupulous care of the physique of the child will render unnecessary these conditions, or tend in any way to minimize the acuteness of the situations which rise from them, then it is sound public economy to make some provision for these children.

3. *Educational.*

The discouragement, anxiety and inefficiency which comes to the school child directly and frequently indirectly as a result of some such physical impediment as defective teeth, it is impossible to tabulate or tell. It often takes the form of dissuading the child from higher studies. Saddened and with a profound lack of confidence, the child leaves school—all of which may be a turning point in its career, meaning success or failure in life. The extreme effort the child invests in study is wasted because of its imperfect physical equipment for the task.

VII. DENTAL DEFECTS AND SCHOOL ADMINISTRATION.

The predominant cause of retardation in school can be traced to absences of pupils which affect their school progress. These absences are caused largely by physical inability to attend classes without serious discomfiture and pain. We can all recall the days, no doubt, when with cheeks swathed in bandages we sat dejectedly nursing an indescribable toothache. These absences are more frequent from diseased oral cavities than from any other cause. And in the proportion that we stayed away from school we were losing our lessons and checking our advancement.

VIII. ECONOMIC LOSS TO EDUCATIONAL SYSTEM

In the year 1913, 189,840 New York City children failed of promotion. The cost of re-educating this group for one term, based on $19.36 as the semi-annual per capita, equals $3,675,302.40. It is impossible to determine with any degree of accuracy how much of this is chargeable to physical defects—dental disease being the most common of them all. It is undoubtedly true that much of this sum probably could be saved by keeping the children in good physical trim. Non-promotion is largely caused by loss due to absences because of illness. Toothache which makes it impossible for the child to attend school and learn, malnutrition which is frequently the result of defective teeth, render the child incapable of efficiency as a student. If it is possible at all to minimize the number of children who are retarded owing to the condition of their mouths or other physical disorder, we shall be

in a position to save the city a large sum of money now spent on re-education of backward pupils.

IX. CERTAIN ASPECTS OF THE DENTAL CLINIC

Three phases of the dental scheme might be considered here: 1, Physical; 2, Professional; 3, Educational.

1. *The Physical.*

In order that the dental scheme may be carried out with the least friction, with a minimum of lost movements and maximum results, it should, we believe, be located in the school building proper. If we organize dental clinics for school children, it is but logical that they should be located where the school children are to be found. The adequate control by the educational authorities over the school child during school hours would make friction improbable. It would be necessary merely to send the child from the class-room to another room in the school building for dental treatment.

This location—by no means new or untried—forms part of that worthy movement which seeks the widest possible use of the school plant. By locating the clinic in the school building, such costs as janitorial and orderly service, light, heat, rent and other fixed charges are merged with the costs of the educational system and would be found to be small compared to what they would be if separate buildings, equipment and service were to be maintained outside.

2. *Professional*

The clinic should be in charge of a capable dentist adequately paid, who should be required to devote, for the present, half his time to this work. He should be chosen not merely for his technical skill but with due regard to his capacity to handle children.

A dental nurse should be present to relieve the dentist of the collateral work of sterilizing instruments; to prepare children; arrange appointments; follow up cases; keep records and instruct children generally in oral hygiene.

A supervising dentist in charge of all clinics should preserve the records of work done, supervise clinical research, standardize and unify methods of treatment, keep abreast of all advances in

dental hygiene, in order that any new step duly recognized which would tend to benefit the child be taken advantage of.

A registrar, who ought to be a statistician, should be in charge of all the record keeping and should tabulate, analyze and interpret the actual work performed by the clinic.

3. *Educational.*

The clinic should serve as a center for the dissemination of all intelligence on oral hygiene.

Consultation hours should be held when mothers with children of pre-school age may come for advice on the cleansing of the teeth of infants. This is justifiable from the standpoint of the clinics being under the jurisdiction of the Bureau of Child Hygiene.

It should be possible for parents to procure at this station prescriptions for mouth washes and tooth cleansing preparations.

Leaflets in the language of the predominating race of the district where the clinic is organized should be distributed on all matters relating to oral hygiene.

X. THE SOCIAL SIGNIFICANCE OF THIS MOVEMENT

Dr. William R. Woodbury, neurologist in the Boston Dispensary, in an article reprinted from the Boston *Medical and Surgical Journal* of July 1, 1909, thus tersely analyzes the social value of the oral hygiene movement:

"A community can make no better use of its taxpayers' money than to afford them the protection which health inspection of school children gives. The care of the child is the conspicuous subject of the year. The care of the teeth is an important factor in the care of the child. Soon, school health inspection will be the rule in every city and town. The mental and physical efficiency of school children can be greatly augmented by the proper care of the mouth and teeth. This is fully attested by the experience in Germany—an experience which covers a wide field. Dental infirmaries connected with the schools have been in operation in that country for a sufficient length of time to demonstrate:

"*First.* That the time expended in putting the teeth in order was far less than the time formerly lost from toothache and disability caused by diseased teeth.

"*Second.* That the cost of keeping the teeth in order was more than compensated for by better health and a consequent reduction in hospital expenses.

"*Third.* That the child became physically stronger, secured a higher average in his studies, was easier to control and was apparently happier.

"Diseased teeth are a fruitful cause of disturbances in other parts of the body, and hygiene of the mouth has a direct connection with, as well as a controlling influence over, the health of every individual."

For each year that we postpone the adoption of a progressive program for the prevention and cure of dental diseases and defects, we are mortgaging the future with a race of degenerates, physical or mental, for whom the future generation will be obliged to provide hospitals and almshouses, sometimes prisons, to protect society against the train of misfortunes which follows in the wake of society's neglect to maintain a high standard of physical efficiency.

Sydney and Beatrice Webb, in their book on the Prevention of Destitution, tell us of the custom of the Australian squatter, who annually rounds up his uncounted flocks and herds for an inventory. If it were possible for us here in New York to muster, as in a monster parade, all the children in need of dental treatment, and were these to go by in single file, it would take nearly a month of constant marching, day and night, to review them from a given point.

There is a minimum of physical development under which society must not permit its children to fall.

XI. THE SOCIAL EFFECTS OF PHYSICAL DISABILITY

Pauperism is an indication of national decay. Sickness, most of which we are advised is preventable, more than any other single agency augments the army of the destitute. Here we have dental defects among over a half-million school children—all of them exposed to the more serious consequences of such neglect. Only in the proportion that we unstintingly and wisely spend money and effort to revitalize the exhausted energies of these children and redeem them from the realm of potential physical misfits and de-

fectives, may we expect to bequeath to future generations a race of efficient social beings.

If, on the other hand, we are satisfied to permit the neglect to go on unchecked, we will be flooded in our industrial field with children who, dismayed at the struggle of keeping up in school, will leave school in a condition of unpreparedness which will eventuate in working inefficiency. Through this inability to reach the reasonable expectation of industry, the child's progress in labor for hire is inauspiciously launched. The child will drift from place to place, unsatisfied, restless and saddened—'little knowing that this unfortunate condition may be merely the result of some physical defect such as unsound teeth or any of their concomitant evils.

THE CAST GOLD INLAY: ITS PLACE IN OPERATIVE AND PROSTHETIC DENTISTRY[1]

By William D. Tracy, D.D.S.

When the term " inlay " is used in the general sense it does not convey to the mind anything new or even modern, for inlays of various types have been used in dentistry for a great many years—notably, bits of porcelain ground to fit irregular cavities as closely as possible, circular sections of porcelain rod cut off and inserted in strictly circular cavities, the glass inlays baked in a matrix and set into cavities in which the matrix had been formed—and later the more perfect porcelain inlays using both the low fusing porcelain prepared by Dr. Jenkins, and the high fusing porcelain bodies. In addition to these may be mentioned the two-piece gold inlay, which was made upon an amalgam die, having an inner shell of pure gold swaged to fit the cavity, and an outer shell of 22 k. gold to form the exposed surface, and restore the lost contour of the tooth.

All of the foregoing were used for many years, and served good purpose, aiding dentists in the saving of a countless number of teeth.

But when one mentions the " cast gold inlay," a process that is distinctly modern is brought to mind; as many of us will remember that the cast gold inlay and the scientific device for making it, together with all the details of a remarkable technique, were presented to the dental profession by Dr. William H. Taggart at a meeting of the Odontological Society of the City of New York in January, 1907—nearly seven and a half years ago.

One often hears the question, " Has the cast gold inlay come to stay, or is it another will-o'-the-wisp, of which the dental profession has seen so many in the last quarter of a century? "

In the mind of the writer there is only one answer to this question, and that is: " The cast gold inlay has come to stay; " and, moreover, it is safe to say that history will count it as one of the greatest advances ever made in the filling of cavities in

[1] Read before the Vermont State Dental Society, Rutland, May 21, 1914.

natural teeth, and in the restoration of lost tooth structure and lost dental function.

Every dentist has seen indifferent and poorly fitted inlays both of gold and of porcelain that have saved the teeth in which they were inserted for a great many years, even though the edges were imperfect, and a proper contour may have been lacking.

If inlays of this type have remained in place, and have saved defective teeth for many years at a time, is it not reasonable to believe that a cast gold inlay, which fits the cavity with the greatest possible perfection, will be a great deal more lasting?

Ever since 1907 many of our ultra-conservative men, a number of whom are among our best operators, have inveighed against the insertion of gold inlays as being an uncertain, and even a dangerous procedure—"uncertain" because they have not been proved by the test of time to last well, and "dangerous" because they feared that the extensive cutting necessary in some cases would result in the death of the pulp.

In these days of transition and rapid development in the science and art of filling teeth the conservative dental mind plays an important part in helping the dental profession to maintain its balance, and to proceed with caution along new and untried lines. Pitted against the conservative, on the other hand, we find the enthusiast who takes up each new thing that is presented, uses it in all cases, heralds it among his patients as the great solution of all troubles, and crowds it to the utmost limit.

As a result of the ultra-conservative view, we still see many cavities in bicuspids and molars where fillings of gold, amalgam or silicate cement have been placed, which may "save" the tooth for several seasons, but which in no sense "restore" that tooth to its proper form or proper function. And at this point I would request you to grasp the fact that there is a large difference between "saving" a tooth and "restoring" a tooth. Many a first molar has had a mass of amalgam packed into it, after which the amalgam was wiped off with cotton and allowed to crystalize. Those teeth have been saved for many years, but they were never truly restored, as far as their masticating function was concerned. Fillings of the same type were, of course, also made with gold and possessed the same defects.

And in view of our present day knowledge of the importance of the function of mastication, as related to general health, and of the importance of the individual tooth, as related to the masticating organ as a whole, it seems absolutely wrong that patients should be denied the right they have to a better kind of dentistry, which includes " restoration " as well as " saving " of the teeth.

As a result of the more radical and enthusiastic view point, we have to admit that the cast gold inlay has, in many instances, been abused and brought into disrepute; not because of any inherent defect in the principles involved in its proper use and construction, but because of a lack of care, or a lack of understanding, on the part of those who have misused the method.

It is also true that the carrying out of the inlay method as general routine practice does involve more cutting of tooth structure than used to be done in the old days of non-cohesive gold foil and amalgam filling; but the necessity for the extensive cutting of tooth structure, as practised by many of the best operators of to-day, was pointed out by Dr. G. V. Black many years before the introduction of the cast gold inlay, and the chief, if not the only, reason why more men have not adopted the " extension for prevention " theory as a rule of practice, is that when cavities were prepared according to the suggestion of Dr. Black the time and labor of filling them was so much greater than it was when the old-fashioned haphazard cavity formation prevailed that the average man was deterred from adopting the Black method.

With this fact in mind, then, the cast gold inlay may be looked upon as a factor in the development of a better technique in cavity formation; because extension of cavity margins into areas of immunity, and the thorough excavation of pits and fissures, does not mean an extra hour of laborious and painful malleting of gold foil. It does mean, however, that when that cavity is restored with a well-fitted and carefully contoured and finely polished gold inlay, that the prognosis for that operation is most favorable, providing that the details of the work have been properly carried out.

The bugaboo of thermal shock, inflamed pulps and dento-alveolar abscesses that was heralded by some men as the certain harvest for those who resorted to the use of many inlays has

not materialized, and among careful observers it is pretty generally admitted that there are more pulp complications under fillings where thorough excavation has not been carried out than in teeth which have been restored by large fillings or inlays placed in cavities thoroughly excavated according to the accepted methods of extension for prevention.

The prevention of thermal shock after the setting of gold inlays is quite as possible as it is in the use of other metallic fillings. In deep seated cavities it is always well, after excavation is completed and the cavity has been sterilized, to line the cavity with oxyphosphate of zinc as a protection to the pulpal wall.

That portion of the wax core which comes nearest to the pulp can be reduced and hollowed out by the use of a Roach wax sucker after the core has been placed upon the sprue, thus keeping the gold of the finished inlay away from the part of the cavity where it would be most likely to produce discomfort or damage to the pulp.

Where extensive exposure of dentin occurs, as in some cases is necessary, it is wise to dry the tooth and wipe the dentinal walls with a 50 per cent. solution of silver nitrate, leaving it in contact with the tooth structure for a moment or two. This treatment coagulates the albuminoid contents of the dentinal tubuli at their exposed ends and renders the tooth much less susceptible to thermal changes.

Only a few days ago Dr. J. V. Conzet, of Dubuque, Iowa, one of Dr. Black's most successful followers, was heard to say that the only difference between the proper preparation of a proximo-occlusal cavity in a bicuspid or molar for an inlay and for a gold foil filling was that, for the former no undercut is permissible and in the latter a slight undercut is necessary.

Thus it would seem that those who are looked upon as authority in a study of these questions do not feel that the use of gold inlays necessarily involves an unwarranted sacrifice of tooth substance.

One of the most important details in the education of the student is to inculcate in his dental mind a reverence for tooth structure; but that reverence must not blind him to the fact that if reasonably permanent results are to be gained in crowning,

filling, inlaying and in other restorative operations upon the teeth, a certain amount of tooth structure must be sacrificed.

The reverence for tooth structure which used to cause some of our best men to retain in the mouths of their confiding patients old roots of teeth on which there were chronic abscesses and loose, pyorrhea teeth that were held in for months, and sometimes for years, with wire and silk ligatures, meanwhile harboring foci of disease and infection, is no longer considered laudable.

The idea seems to have gone abroad that many of the men who stand as advocates of the cast gold inlay use it in all classes of cavities where a metallic filling is permissible, and there may be some who do go to this extent; but most of the good operators whom it is the writer's pleasure to know, feel that the old and time-honored methods of filling all hold their places of usefulness in certain selected cavities, but that for practically all proximo-occlusal cavities in bicuspids and molars, many cervico-buccal cavities in superior and inferior molars and inferior bicuspids, disto-proximal cavities in superior cuspids, and the many large restorations involving the major part of molar teeth, may best be dealt with by the use of the cast gold inlay and its elaborations.

In view of the fact that cast gold inlays which were put in some years ago, during the time when most of us had but little mastery of the technique, are still intact, doing good service, and showing no tendency to recurrent decay, it seems entirely justifiable to look upon them as successful operations.

During the seven years that have elapsed, the problems and general requirements of cavity preparation have been studied out by individual operators and a more thorough understanding of the laboratory technique has been acquired, so that to-day men in all parts of the world are making inlays that are far more perfect in their mechanical details and more serviceable as restorations of the lost parts.

While a few men have made inlays that were good in the details of their anatomical conformation, the rank and file of dentists seemed to think that a plug of gold that sealed the cavity when cemented to place was all that was required.

The stimulus given to cast gold inlay work through essays

written by Dr. J. Lowe Young, Dr. H. W. Gillett, Dr. R. Ottolengui and others, who pointed out the necessity of reproducing the minute anatomy in masticating surfaces of the gold restoration, has been of great value, and has caused a marked improvement in the handicraft of many operators who are striving to do the best work.

These writers pointed out that the marginal ridge and the proximal contact point were not the only details to be obtained in the wax core, but that the cusps, the occlusal planes, the pits and grooves, the sulci and the subsidiary sulci, as Dr. Ottolengui chooses to call them, must all be reproduced in order to attain maximum efficiency. This simply meant carrying out the regular technique to a point of greater nicety and is the routine practice in the offices of a great many inlay workers to-day.

The inlay was looked upon by some men as a quick and easy method of dealing with compound cavities; but in most cases these men were disappointed, for, comparing it with the old slipshod methods of filling teeth which so many dentists use, it is neither quick nor easy, and the chief features which recommend it to the careful operative dentist are those that make it a scientific, accurate and successful method of restoring decayed and broken down teeth to usefulness and comfort. In addition to this, it does spare the patient a great deal of discomfort and actual pain by eliminating the packing of large masses of gold foil.

Still another virtue possessed by the cast gold restoration is that many badly broken down molars, and some bicuspids (where display of gold will not be evident) which a few years ago would have been crowned, may now be built up to perfect occlusion with restorations which protect the remaining part of the tooth, and do not in any way impinge upon or irritate the gingival margins as do so many of the crown bands which are constantly seen.

The foregoing paragraphs have dealt mainly with the inlay in its relation to operative procedure, but its usefulness extends into the field of mechanical dentistry as well, and in the construction of prosthetic pieces it has long since made for itself an important place in the hands of many men.

Combined with an iridio-platinum post, cast integral with the inlay, it serves as an admirable attachment for small pieces of fixed bridge work, and when combined with an iridio-platinum tube cast integral with the inlay it is equally serviceable as an anchorage for the split pin attachment which is so much used in removable bridge pieces.

In partial gold plates, where clasps and lugs are adapted to natural teeth having crowns upon them, the lug may be attached in the form of an inlay to the clasp, and made to fit perfectly into a lug socket especially constructed in the cast gold crown to receive it.

In the construction of pieces which include the use of the Gilmore attachment, cases constantly arise where the extension arm may be attached to an inlay with post, or to a cast restoration, thus avoiding the necessity of a crown.

Various applications of the gold inlay, both in operative and in prosthetic work, which are not mentioned in a brief paper of this sort, will commend themselves to the mind of the dentist from day to day.

THE USE OF AMALGAM FILLINGS *vs.* GOLD INLAYS, IN BROKEN DOWN MOLARS[1]

By Herbert L. Wheeler, D.D.S.

Since the days when it was the universal custom to speak of teeth as " hard " and " soft " much has been added to our knowledge upon the subject of the cause of dental caries. That the terms used by the profession for many years to describe teeth as hard and soft had some basis in fact, I am prepared to believe, for while we know that the composition of teeth in various mouths is so near the same that it is practically impossible to find a difference in their chemical composition, still there is something beyond the mere fact that you have a tooth substance of unvarying composition and a universal similarity in conditions that produce decay. It is probable that the final word as to what produces immunity from caries and that which makes for an increased tendency to dental caries will not be said for many, many years.

The present researches along the line of finding out what conditions obtaining in the fluids of the mouth make for an increased tendency to decay, and those which make for immunity, I feel are along the right lines. Up to the present they have given us much useful information, and apparently will give more in the future. I am inclined to think, however, that as the theory of hard and soft teeth was one step towards a better knowledge of the conditions that produce dental caries, the investigation of the environment of the teeth in the fluids of the mouth is but another, and I am prepared to believe that some time in the future it may be found that the vital power, the strength to resist attacks from external pathological microorganisms, will be found to play its part in obtaining a condition of immunity from the disease dental caries.

In dealing with the subject of this paper I do not consider it essential to discuss the various problems included in the theory of extension for prevention. I am not, and never expect to be, convinced that any filling material that human ingenuity may

[1] Read before the Mass. Dental Society, May, 1914.

devise or human hands place is, or will be, superior to the material which nature has used to form teeth; but as my paper deals with broken-down teeth (meaning thereby those in which the cavities áre so extended that the enamel walls have been greatly weakened or possibly broken away), extension will, in many instances, be a necessity in order to obtain the required edge strength around our fillings.

First, let us deal with the possibilities of gold inlays. I fully appreciate the advantages that have come to us in many, many instances through our ability to cast and place gold inlays where previously, in order to use gold, the patient had to be subjected to a long, wearing, and sometimes nerve-exhausting sitting while the dentist indulged in a physical and nervous strain in placing the gold filling that probably has had much to do with the early demise of some of our exceedingly fine operators. It must be remembered, however, that several things are essential in using a gold inlay. Whether we use the indirect method or direct method of obtaining our wax models, it is absolutely essential that our walls be parallel at all points, or that the cavity, in a general way, shall form an inverted truncated cone. This means that the base of the cavity must, of necessity, be the exact width of the orifice, or narrower—never, under any conditions, broader. The result of this hard and fast necessity in the preparation of cavities for inlays often means the cutting away of cavity walls and enamel prisms to an extent that very much weakens the tooth, and probably will result in the gold being of considerably different shape and contour than the original enamel of the tooth.

The weakening of the tooth by cutting away of the enamel walls, and sometimes much of the body of the dentin, is not the only unpleasant and undesirable thing that is sometimes apparent in the use of gold inlays. Another undesirable feature is the necessity for doing a great deal of cutting with a bur. This immense amount of cutting is very painful and very trying to many people. In fact, many patients find a revolving bur in an engine so uncomfortable and painful that they will willingly sit in the chair much longer, greatly increasing the cost of the service to themselves, in order to have the work done by hand and with hand instruments.

And this is not all. For after you have cut away your walls so as to exclude all curves, and have obtained perpendicular parallel sides with a base no wider, or possibly narrower, than the top of the cavity, and after having cut away much good, sound and frightfully sensitive dentin, you still have very large prospects of imperfections in your filling. If you use the indirect method and take an impression, there is always the prospect of a slight movement in the impression material which, though it may be so slight that it is not observable, certainly is not so slight but that a space may be created which, in due time, will attract pathologic bacteria as the early caves attracted the cave man when he desired to find shelter. If you use the direct method and place your wax for models directly in the cavity, there is also a possibility of a slight moving or bending or giving of the wax, which, if it does occur, will invariably produce a slight imperfection in the inlay.

But supposing that there have been no misfortunes of this kind and the inlay process, up to the time of investing your wax model in the investment compound, has been perfect and without a flaw—what assurance have you that there is not slight shrinkage or expansion in your investment material? How do you know that your expansion or contraction is even all over the surface of that inlay cavity; and are you certain, in case it is possible, under qualified conditions, to overcome the question of contraction or expansion, that the material has been mixed in such a manner that you will get the same results under any and all circumstances? I think not. But granting this to be correct, and granting perfection up to and including the casting of the gold inlay, can you set a gold inlay, or any other kind, without having a thin film of cement between your inlay and the wall of the cavity? To be sure, this is so slight that under many circumstances it is possible to burnish the edges of your inlay to such an extent that this crevice, filled with the cement which has been used in the setting of the inlay, will be entirely covered up. Under those circumstances, with a properly contoured inlay, a properly shaped cavity, and in a tooth which is fairly immune from dental caries, you can get most excellent service from the use of gold inlays.

There is another thing to be considered, however, in using

gold inlays. I believe the use of an oxyphosphate cement in a deep-seated cavity to be more likely to cause pulp destruction than amalgam. At least this has been my experience in a practice of twenty-four years, during which I have been a somewhat careful observer.

Another consideration (which we need not think of in some of the larger and wealthier practices of our great cities) is the great cost of preparing for, making and placing thoroughly good gold inlays. In the greater number of cases, however, the men who have been fortunate enough to obtain the wealthy and cultured practice are comparatively few; and the question of expense must be considered. Where this question does confront us, I believe that a very extended use of gold inlays in molar teeth will be disastrous alike to the dentist and the patient, and in all probability may cast considerable reflection, in a general way, upon the standards of intelligence of the dental profession.

It is evident, from what I have said, that I consider the use of amalgam in large molar cavities, in a vast majority of cases, as preferable to the use of gold inlays. This is a correct inference. I not only consider it more desirable in most cases, for the reasons which I have given, but I consider it more desirable in most cases where dentists have a practice so wealthy that the fees do not have to be a matter of consideration on the part of the patient. If, after years of practice, I have come to this conclusion, there must necessarily be reasons for this conviction on my part. And there are.

In the first place, my experience has led me to the conclusion that in a majority of instances of large cavities in teeth—incisors, bicuspids or molars—the decay extends in such a manner as to make it possible to obtain parallel walls in every direction only at the expense of much good and strong tooth structure; and I again wish to reiterate my faith in nature's ability to produce a material in the making of teeth in the animal economy that is far superior to any substitute that man has, or ever will be able to produce. For this reason, it is my belief that the best interest of my patients is more intelligently served by me when I preserve as much tooth structure as possible for future usefulness than it is when I destroy tooth structure in order to utilize a material which fancy, and not facts, has ever tried to claim to

be superior, as a filling material, to anything else that can be used.

I am almost prepared to accept Dr. J. Foster Flagg's dictum, that in proportion as a tooth needs saving, gold is the very worst possible substance to use. Whether this is so or not, it is certain that where there is a tendency to rapid decay in the mouth of a patient, gold not only does not preserve the teeth in that mouth better nor prevent a more rapid recurrence of decay, but, on the contrary, it often appears to be less able to do so than almost any kind of filling material one may use. I think it is safe to say at the present time that the question as to whether a tooth is filled or not filled, whether it is filled with gold, cement or amalgam, has nothing whatever to do with the tendency to a recurrence of decay on other surfaces of that tooth or a tendency to immunity from decay in the mouth of any particular individual. There are conditions which produce rough edges, where various kinds of debris and material mixed with mucin in the mouth may collect and produce those conditions which invariably produce destruction of tooth structure. And these conditions are as liable to occur in the use of gold inlays as in the use of a good amalgam intelligently placed. I am inclined to think they are more liable to occur (given the same amount of skill and ability) in the use of gold inlays than with amalgam fillings.

In the first place, at the present time the possibilities of making or securing proper matrices so that one may intelligently pack amalgam are so great that the man in the most distant country town, or in the least lucrative practices amongst the poor of our cities, may find it possible to make an amalgam filling of the very best character and quality. Amalgam of a proper composition, carefully placed and properly shaped, may produce conditions that are as free from prospects of recurring trouble as it is possible to obtain in the insertion of fillings in human teeth.

Now, what are the advantages to be considered in utilizing amalgam in these large cases? I maintain that it is not only superior in most cases to gold inlays, but far and away superior to gold caps; in fact, my feeling about gold caps is so strong (while I realize their utility in certain places and upon certain occasions when used intelligently) that I am prepared to state it is my firm belief that if gold caps had never been known up

to the present time, the welfare of the human teeth would have been advanced.

Now, in preparing a cavity for an amalgam filling, the first advantage is that we do not have to destroy a whole lot of good, sound tooth substance in order to change our curves into straight lines in cavity preparation. In the next place, we can prepare the cavity proper, often doing much or most of the work by hand with much less strain upon the nervous system of the patient. In the next place, experience has convinced me that amalgam is borne much more readily by tooth structure without irritating the dental pulp than is oxyphosphate cement. In the next place, amalgam can be polished and its edges made perfect (if the work has been done properly up to this point) much more readily and with greater comfort to the patient than can be done with gold, either as inlays or the old-fashioned foil filling. In the next place, looking into the mouth, there are few situations where, in speaking to a patient, the light is thrown strongly enough beyond the bicuspids to call attention to or cause one to notice any kind of a filling in a molar tooth unless it be a brightly polished gold filling or a gold cap. The lustre of these hideous things makes them at once conspicuous in case they are placed in a straight line of the vision of any individual looking into the mouth of a person in which these gold ornaments have been placed.

In making these statements concerning amalgam, I wish to be clearly understood as dealing entirely with a condition in which a matrix is used to give you a substantial wall to pack up against where any of the walls of the tooth have been lost. I am not discussing in any way those cases where amalgam is used as a putty and plastered on about as we used to putty up a window light when, through youthful misfortunes, the baseball had gone into the house through the window.

We then have these advantages to the dentist in the use of amalgam. It requires less destruction of good tooth structure where amalgam filling is to be used. It requires less use of the electric engine. It is more certain to go exactly where it is placed, with no danger of its drawing away if properly placed and leaving a crevice for the accumulation of bacteria. Of course, I am speaking now of the application—and intelligent application

—of the modern non-shrinking amalgams. It takes less time, can be more artistically shaped and carved with less wear and tear on the patient, and gives you as smooth a surface, which is as readily cleansable, and as good edges, if properly polished, as any other form of filling material. On the side of the patient, it makes a shorter sitting—which I believe to be to the patient's advantage—it is less painful and fatiguing to the nervous system; it is less complicated in most instances than a gold filling. can be polished and shaped with less discomfort to the patient, and in most cases will last as long or longer than any other kind of filling that has ever been devised. Proper occlusal surfaces can be more readily produced, smoothed margins can be more easily obtained, and in case of trouble with the pulp at a future time it is much easier to enter the pulp chamber directly through an amalgam filling than it is when gold has been used or when porcelain, and in some instances, silicate cement has been used.

Another thing, if recurring decay does come (and it is quite as liable to come after a gold inlay has been placed as it is beyond the margins of an amalgam filling), it is again much more readily repaired, and much more thoroughly and properly repaired, than it is possible to do with gold inlays. I have no brief for or against any kind of filling. What I want is to find the material that will give my patients the greatest comfort and utility with the least destruction of tooth structure and the least wear and fatigue upon their nervous system; and long before the advent of gold inlays I became convinced of the superiority of amalgam for building up molar crowns, over the usual gold cap employed, and largely for the same reasons that I have enumerated as its advantages over gold inlays.

The most perfect fitting gold cap has some edges which are liable, in many instances, to act as retention points for masses of decomposing material agglutinated with the mucin. This trouble can be entirely done away with by proper finishing and polishing of amalgam; and it can be done as cheaply, or more cheaply, than the fitting of a gold crown, with much better results to the patient. I still maintain, as I have for many years, that the chief aim of a dentist who is, in any sense, a professional man, is to give his patients the greatest comfort and utility, with the least trouble and expense to them that is possible; and I

believe that this consideration should outweigh the question of some particular kind or type of filling which the fad or fancy of the hour dictates as the proper thing; and because I believe this, and because of my experience of over twenty years, I am still convinced that a plastic filling with as many good qualities as our modern amalgams, will give greater satisfaction in most locations in the mouth, and look as well where a strong, direct light does not reach it, as any other material that it has yet been my privilege to use.

To be sure, advocates of the inlay method will claim superior advantages in the matter of contour, and it must be admitted that it is easier, at that particular point, to scrape a wax model into an ideal shape or contour than it is to produce a matrix from which contour may be obtained and retained; but this does not make so much difference as may appear. Modern amalgam sets very rapidly; and in case a matrix is left in place for ten minutes, or twenty-five minutes at the longest, it can be removed, even though it is concave, in order to allow for curves in the contour of the filling. From the number of gold inlays which I have had to remove, owing to the fact that they were not contoured and that recurring decay had commenced at the cervical margin, I am inclined to believe that the question of contour is one that does not enter as largely as it should into the plans of the average dentist. The proper contact of proximal surfaces of teeth would do more to prevent many cases of pyorrhea, which now sorely trouble us, than almost any other remedy I know. But as Kipling says, " That is another story," and I will not take it up here.

The only thing that I shall hope to have suggested to you in this short paper is that, intelligently used, conscientiously shaped and fashioned, amalgam will produce as useful and satisfactory a means for the reproduction of lost parts of decayed teeth as any substance I know; and the man who so uses it need not apologize to his patients for his work at any time. He may rest assured that his services to his patients are equal or superior to those of many who make great claims now, as of old, concerning the superiority of gold; and he need have no compunction about charging the patient such fees as he may feel that his time and skill are worthy of.

RECENT TENDENCIES IN MEDICAL EDUCATION: THEIR CAUSES; THEIR DANGERS, AND THE REMEDY [1]

By Charles F. Painter, M.D., Boston.

I have chosen this subject upon which to address you to-night rather than upon something connected with orthopedic surgery for two reasons. In the first place, my attention has been a good deal occupied of late with the subject, and, in the second place, my association for the past few years with those who have been dealing with the matter from the point of view of the medical and dental schools has led me to believe that the subject concerns each one of us, and the profession at large more vitally than we often have time to think that it does.

The requirements of such a civilization as that which at the present moment is seething on this continent, has brought problems for the solution of those charged with the adjustment of an educational system to those needs, which have not as yet been met. An ignorant immigrant population has been pouring in which had to be amalgamated, and education has appeared to be the best solvent to use in the process. A world of business development along multitudinous lines has been constantly calling for men and women whose training had been specialized so that they were prepared to enter particular lines of business without the handicap of utter ignorance regarding the fundamentals of that business. Competition in all lines of industry has become so keen that competency, not merely success, demands specialization, that is special education, in every line.

The consequence has been that our general educational system has been developed to meet these extraordinary demands, and the majority of our grammar grade pupils now, instead of entering classical high schools, enter schools for the mechanic arts or other strictly technical and vocational institutes, where emphasis is laid upon subjects which fit for efficiency in some trade or industry immediately after graduation, or else their education ceases. Relatively few of our children go through the classical

[1] Read before Metropolitan District of the Mass. Dental Society, Boston. April 6, 1914.

high school courses, and for many of *these* the course is not a stepping-stone to college. For those who elect to enter upon a business career or join the ranks of technical workers, everything is done to make them efficient upon graduation, so that no period of apprenticeship need be served before they can take their place as competent technicians and receive the compensation due those who are so equipped.

This is accomplished by exempting them from the burden of pursuing those subjects which are cultural, and focusing their attention upon those which are purely technical. The community does not, upon this theory, need culture in its technical classes, or if it should not be prepared to admit this, it would say that this might be attained in other ways later in life, e. g., by Chautauqua courses and the like. In its professional schools, however, everything is being done to postpone the time when a man is capable of entering upon the practice of his profession. He must have all the cultural studies that a classical high school provides and so much of college work as may be, a part of which shall consist of those subjects, admittedly, the foundation stones of medical science—viz., chemistry, physics, and biology. It is natural that with a general educational system that is seeking blindly to fulfill its mission as satisfactorily as possible to a multitude of clashing interests and still feel justified in being carried on at the public's expense, that dental and medical education should feel the pressure under which all things are being brought in this twentieth century progress.

Physicians and dentists must be qualified to assume the responsibilities of general practice in town and country. They must be trained to perform the more serious surgery that modern progress along the lines of oral and general surgery makes it necessary that they should do. They must be prepared to act upon the Boards of Health of their State or town, exercising that wider knowledge of hygiene and preventive medicine and dentistry in its present-day acceptation. They must be able to serve in many capacities involving knowledge and judgment of no mean order where questions which involve the public welfare are concerned. They must be capable of conducting public institutions for the care of the sick, defective and insane, as well as

the physically crippled. There is not one of these lines of present-day activity that is not so much wider in its scope than it was a decade ago, that in order to perform the duties incident to the task, he who would perform them must be more or less of a specialist in that line. In other words, exactly the same situation has developed in regard to medical and dental education that has developed in regard to general education.

In medical training, however, we have insisted upon the importance of all the old features of the curriculum, adding all the new ones as they have come along, and we have gone on doing this until the candidate for a degree in medicine has dabbled in so many things that only the exceptionally brilliant student is really proficient in anything.

Happily, our dental education *per se* has been free from much of the pernicious meddling of pedagogical experts, though their baneful influence has been operative in the preliminary education of those who have gone into dentistry later. The necessity for regulation of practice by State boards has introduced added difficulties in the problem of preparing students for the practice of dentistry. They are calling for different educational qualifications, both as to the standing of the graduates of a dental school at the completion of the course, the equipment and rating of the school from which they graduate, the preliminary education of the candidate before he entered upon the study of dentistry, etc.

It is probable that many other States will soon follow the State of New York in its insistence that certain standards of preliminary education be certified to before any one seeking a license to practice dentistry in that State may be registered. It will not be enough that they have a certificate of graduation from a high school outside of the State of New York, but that certificate must satisfy the standards imposed by the Regents of the State of New York.

At a time when educational matters are being overhauled, when the public is becoming more or less aroused, and the professional educators are looking to their laurels, it behooves those who are concerned with education in special lines, to study the

problems a little themselves, so as to act intelligently at such time as they may be called upon to do so.

As you know, the Council on Medical Education of the American Medical Association, working in conjunction with the Federation of State Boards and the Association of American Medical Colleges, decided that there are too many doctors; that they were unable, many of them, to obtain a livelihood; that many enter the profession for mercenary motives only, and with low standards of admission there would be a greater proportion of such practitioners than there would be with higher standards; that many medical schools were ill-equipped and were being run for profit to their promoters; that there was no need to consider the " poor boy " in the matter of getting a medical education. He could, if he was serious in his desire, obtain his education in any of the worthy schools.

Much of this criticism was justified. There were a number of poor schools. In many places there were more schools than the community could properly support, just as there are more churches in some towns than the spiritual necessities of the community require. Standards were low in many institutions, and students were being graduated without proper knowledge of the profession of their adoption. The number of schools has been cut to about a hundred, and the number of medical students by several thousand. The goal that the Council hopes to attain in number of schools is about seventy for the entire country, with a minimal entrance requirement of two years of college in addition to the four years in a high school. In this two years of college, it is prescribed that chemistry, biology, physics and a modern language shall be a part. It is hoped to make this and some other additional requirements, such as an added or fifth year of hospital work, the minimal requirement for all who would be graduated as physicians.

Already the Carnegie Foundation has commenced its preparations for the investigation of the dental schools of the country, and there will be a standardization of dental educational requirements based upon the recommendations of the Carnegie Foundation. It is safe to predict that weak schools will be found; that more dentists will be discovered than there is any

need for, and many other grounds for criticism, not only of the results of dental education, but of the manner in which it is carried on and the material that is admitted to the schools.

What I wish to bring to your attention particularly to-night, is the advisability of your profession giving these matters careful thought so that you may not be stampeded into action that is unnecessary and capable of inflicting hardship on many worthy men and women who desire to enter the practice of dentistry. The medical schools unquestionably have been stampeded to a certain extent, and there is no doubt that though the Carnegie Foundation and the Council on Medical Education have rendered a great service to the country, that they have, and are still, striving for entrance standards which must be modified very considerably in the near future, for the reason that the country is being aroused over the conditions of our secondary and high schools. We are wasting a great deal of time in these years of school life, and, more than that, the children are not being taught satisfactorily the thing of all others that they should be taught, and that is how to study. If students enter the dental schools now from the high schools of this section of the country, who don't know how to spell or write respectable English—and I doubt if any one familiar with the work done in this respect will deny that this is the case far more often than it should be—it is not likely that a year of college work in biology, chemistry, physics, and a modern language is going to make up for those fundamental defects.

I know it is not proposed as yet that a dental student should be required to take this added year, but the medical student is now required to do this, in order to remedy such defects in his education as his coming up to the studies of the first two years in the medical school not properly prepared to undertake the subjects he is then obliged to pursue. If this is the way to remedy the medical student's defects, it must be equally necessary for the dental student. To do so necessitates his spending a year longer in preparation for his profession, which means more money as well as more time.

Educators are saying now that two years should be saved in the secondary years; that students should enter the high school

at twelve and graduate at sixteen, thus bringing them up to their professional training at a much earlier period—a period at which their mental processes are most active and their minds most productive along certain lines. This change is undoubtedly coming. Would it not, therefore, be foolish to attempt to remedy the prime defect in our educational machinery, as it stands to-day, by simply making the machine grind a year or so longer at the grist? This means a postponement of the time when the flour reaches the market, and it has then lost some of its freshness and savour. An overhauling of the machinery, the elimination of some useless parts which were added because they were thought to be time or labor-saving devices, and have as a matter of fact resulted only in complicating the mechanism, this is all that is needful to render the educational mill capable of turning out its product up to such standards as will prove effective in professional study.

It seems to me that questions involving the standardization of entrance requirements, the evaluation of dental school curricula, equipment and the qualification of professors and instructors are all coming in for consideration by your profession within a very short time, and at the root of the whole matter will lie the question of the preliminary education deemed necessary for entering upon the study of dentistry. I believe that the place where the greatest good can be accomplished is in furthering in every possible way the betterment of our common school education, bringing it back to the old-fashioned basis, eliminating many of the new-fangled, pedagogical frills, and returning to a method that teaches the student how to use his mental faculties. It may be that the three R's will still be found to occupy a prominent place in such a scheme of secondary education.

I imagine that some concerted action on the part of the dentists and physicians who believed this to be true would have much to do in securing a speedier readjustment.

I am not favoring at all a lower standard of admission. I think the would-be dentist and the would-be physician should come into his professional work on the same entrance requirements, and that the minimal should be what it is now for medical schools—viz., an approved high school certificate, plus the

equivalent of the so-called preliminary medical year. I believe, however, that this requirement can all be satisfied in the high schools when we have reorganized these and the secondary schools. We then will have a high school that corresponds to the German Gymnasium, and our anomalous colleges will be merged into universities.

Such are some of the tendencies in medical education of the present day, and, as I see them, their causes.

It seems to me that there are certain dangers incident to these tendencies. First, if not foremost, of these, is the danger that *too* much shall be demanded as a prerequisite for entrance upon the study of dentistry. This is the same danger that all reforms encounter. Human foresight is not far reaching enough to see all the complications which must be met, or to evaluate them properly. Desirable as would be the enforcement of such a standard of entrance requirements as that which demands an academic degree, for example, as a prerequisite for entrance upon the course of dental education, for the majority of men it would not be practicable in this country at this time. One of the medical schools originally imposing such a requirement upon its matriculates has recently seen fit to drop off two years from that standard. Time must be saved somewhere before such a requirement can be made of universal application. There is to my mind some question as to what sort of a curriculum furnishes the best ground work for the study of medicine and dentistry, and whether there should not be some latitude permitted in what may be offered in order to meet the individual peculiarities of mental equipment in those who desire to study these subjects. President Lowell, in a plea for less formalism in admission requirements to the medical school, said, in effect, that it had not yet been proven that scientific subjects afforded any better basis for the pursuit of medical studies than did the classics. Indeed, so far as the figures at Harvard showed, there was a small per cent. of advantage in favor of the classically trained man in a study of 460 medical graduates who had been prepared for entrance to the Medical School by either the sciences or the classics.

If the arguments put forth in the contention that a student who proposes to study medicine requires chemistry, biology and

physics, are good, they are equally applicable to the one who proposes to study dentistry; for the first year's work in dentistry is nearly the same as the first year in medicine. There is no doubt that the preliminary training offered by most of our high schools is not sufficient in its disciplinary qualities to prepare one for the study of medicine or dentistry. For that matter, one hears the same criticism from business men who have occasion to take high school graduates into their employ, and it is common comment from the same sources that college bred men are not of much use in many walks of life until they have forgotten most of their college training. Studies which inculcate accuracy in observation, carefulness and thoroughness in the performance of assigned tasks, attention to detail, persistence in the pursuit of and fidelity to the attainment of ideals, whatever they may be, are the essentials. Mental discipline is what is of paramount significance. It matters little how it is attained. If chemistry, biology, and physics provide the discipline as well as Latin, mathematics and a modern language, those subjects should naturally be the better ones to ground a student of medicine or dentistry upon, but I question whether in the preliminary dental course they are not too advanced to be grasped in their relation to medicine or dentistry, and as mental discipline I am sure they are not comparable to the older subjects; besides, they are not taught so well. All through the grammar grade schools in our public school system, the tendency is to strive to make everything as easy for the student as possible. The " ready-to-serve " principle prevails and hard work is but little known. He accordingly, comes up to his high school and professional experience unused to work and untrained in the art of using his head. It is not to be wondered at that it takes time to learn how to make the attack upon medical and dental subjects.

The result of deferring the time that a man may enter upon the practice of medicine until the age of twenty-seven years, which is now the average, is that this brings the period when he begins to be self-supporting very late, for it is two or three years at least, in urban communities, before he is clear of any indebtedness his education may have entailed and in a position to lay up against a rainy day, marriage, or any other responsibility that

may be or should be his. If it is into the scientific side of medicine that he elects to go, then he has used three or four years of the most productive of his whole life, and at twenty-eight to thirty, when he might begin to devote himself to his scientific or research work, he has lost some of the best of his life. If he had no independent means of support he has lost more than that. We certainly cannot say to the poor but talented man who realizes that his abilities and his tastes draw him toward scientific research along medical lines, that he must not think of such a career because it takes so much time to prepare for it, when it is possible to equip oneself in considerably less time and utilize some of the best years of his life by so doing. So it seems to me that, granting the need of the broadest possible cultural preparation for the calling of the physician and the dentist, and the necessity for protecting the public from impostors and all kinds of charlatans, we must not fall into the error of countenancing either a secondary education which is not primarily disciplinary in character, or, with the idea uppermost in our minds that the would-be practitioner must be liberally as well as scientifically equipped, protract the period of his preparation for practice or research beyond the time when his greatest development should naturally take place. If the first years of his practice must be years of hard labor to establish himself and earn a living, there is no time nor energy left for that which may mean a contribution to the cause of the clinical or scientific side of his chosen profession.

Much has been said, as you all know, in regard to the poor boy and his chances to secure a medical education, and the hardship of closing the doors of professional schools on him because of his failure to be able to meet the high requirements in both expense and expenditure of time. The poor boy who is also an undesirable student because he seeks schools with low standards in order to obtain that which he ought not to have and which he intends to abuse, is one thing, and both he and the school that admits him should be eliminated; but there is a large class of young men who are earnest in purpose, possessed of a mental equipment fully the equal and often the superior of that possessed by a majority of those better conditioned, to whom the closure

of the portals leading to a medical or dental education is a hardship, when such closure is based upon a failure to comply with *some* of the present day requirements. To a boy of determination and earnest desire to make the most of himself, a district school training in the three R's, and not much else, brings him to the time when he can profitably study medicine just as well trained, and I submit oftentimes better able to study, than his more fortunate brother who has been *sent* to preparatory school and *made to go through* college. It is " the man behind the gun " who must be taken into account more than is the case at present in our modern system of qualifying students for the study of medicine, and we must not lose sight of this fact in the refinement of entrance requirements. We are very particular about a candidate having fractional parts of a unit of qualification in some very minor subject, without which he must spend an entire year longer or else give up altogether the idea of studying medicine, and yet, except for a purely perfunctory insistence upon the candidate bringing a certification from his pastor or some one who has known him, to the effect that he is of good moral character (and all that is meant by that is that he is not a criminal), we take no pains to find out whether a boy can measure up to standard in a profession where his manhood, the stability of his character, counts for more than his technical knowledge after he has established himself in practice. We congratulate ourselves that by the work of the council on Medical Education, the Federation of State Boards and the Association of Medical Colleges, we are raising the quality of our medical students, and undoubtedly we are; but we are also cutting out the opportunity to enter the profession from many young men who would be credits to the profession, because of the excess of requirements and the irrationality of procedure in the admission of students into our schools.

I am making no plea, as I said before, for the second rate medical or dental school. I hold no brief in advocacy of less rigorous enforcement of the dental practice acts. I would not see a lower standard of entrance upon the profession of dentistry, but I would like to see a more rational method of attack upon the problem of admission to the profession than is being made at the present time.

The purpose of those who are carrying on the warfare is commendable, their zeal is admirable, but we must remember that there are other matters to consider than the suppression of the quack and the elimination of the undesirable dental school and student. Perhaps there is no better place to begin than at the dental school end, endeavoring to make dental education conform to the ready made curricula of the secondary schools; but to do this is only begging the question, for the essential and obviously remediable evil is located in the preliminary stages of the preparation for dental study as well as in the dental curriculum itself.

To suggest a remedy for the conditions as we find them is not so easy as to point out those matters, which all readily agree are flaws which must eventually be removed.

It is obvious, I think, that no uniformity of dental practice acts can ever be established until these matters are under Federal control. Separate State Licensing Boards, however highminded they may be, are not likely to be able to frame practice laws which shall meet the general needs as well as one central board of control should do. What they, therefore, agree upon as conserving the best interest of the public at large, will enable the dental school authorities the country over to provide their students with such a training as will permit them to enter practice in any State. If legislation had been enacted authorizing such a Federal Board of Licensure, and it did its work well, there would be no need of the activities of various Foundations that seem likely now to take upon themselves the burden of investigating dental education. Commendable as has been the work of such organizations, the presence in the field of so many bodies aiming at the same goal, has been to confuse rather than clarify the main issues.

The superiority of the German's education in medicine is often cited and there can be no doubt of the correctness of the estimate put upon the quality of "medicine man" which that system has turned out. The one fact, aside from the native qualities of mental outlook of the German, which has been responsible for this, has been the State control of all matters educational. The system is built up primarily for the cultivation of the heads

of the profession who become the "Herr Professor Doctors," the Chiefs of Clinics, and the Professors of Medicine in the Governmental Universities. The general practitioner is a by-product in the course of the refinement of the heads of the profession. We can never more than approximate such a system in this country. In the first place we are not mentally disposed as the Germans are, and in the second place, we, up to the present time, are forty-nine separate and distinct units so far as any educational system is concerned. The goal of every man who goes from a German gymnasium into the medical department of a German university is not the field of the successful practitioner, but that of the full professor, at the head of a university clinic. If he falls by the way and is relegated to the ranks of the ordinary general practitioner he has failed in the attainment of that which was within his reach. This is probably not quite as true of dental as it is of medical education.

The spirit of American civilization has fostered a system of education which seeks to supply all the wants of a population bent upon attaining success in various lines of business. Our people are only a superficially educated people in the mass, and our educational foundations are not laid deeply in the solid rock of cultural studies, which means that few students in our schools or colleges do any really serious study—study that means hard work and that results in developing a mentality which can sit down in front of an abstract proposition and solve it by the sheer force of mental effort. The solution of our problem of medical and dental education means, therefore, I believe, such a remodeling of our secondary schools, both as to the character of their curricula and the methods of their teaching, that students shall come up to these courses fully prepared to deal with professional subjects. In consequence of this mental preparedness, the graduate of our medical and dental schools will enter upon his life work at from two to three years earlier than he does at present and will be better fitted than he is now to cope with its problems. Many subjects now taught, especially in the medical schools, will be omitted altogether, and a few not now taught at all will be substituted.

I have thus briefly and very imperfectly, attempted to pre-

sent a subject that I feel sure the medical and dental professions should take more interest in than they now do, as a whole. The influence that these professions wield in public matters is a powerful one, and yet we have never yet succeeded in getting through the legislation necessary to establish a National Health Board. It is certainly of no less importance that we should get through the proper legislative body a bill to establish a National Medical and Dental Practice Board or Medical and Dental Licensure Board. There ought not to be as much opposition to such legislation as there naturally was where so many commercial interests were affected as in the case of the National Health Board and the Pure Food legislation. Public opinion must be enlightened, however, and each of us can, in different fashion, pave the way for the enactment of such legislation.

In regard to the adjustment of the curricula in our secondary schools, it seems to me that the dental and medical professions are in a position to exert an influence here also. Many of the local school boards have a representative doctor or dentist as one of their members. In his own board he can agitate in favor of a less complicated curriculum, for the spending of more time upon subjects that really educate by training the mind in practices which are systematic and accurate. The methods of teaching are quite as much at fault as the subjects taught, I am inclined to believe. I have heard a teacher in one of the best public schools in this State say that the teachers themselves did not know how to teach penmanship because they would hardly master one style before an edict goes forth that another must be taken up in its place. A boy of my acquaintance in the Newton schools, grammar grades, was absent from school for fourteen consecutive weeks on account of his own and his sister's illness, whooping cough and measles, but suffered no loss of time as far as could be observed. He went right on with his work when he returned, and though he was far from a good scholar, as he had never been taught in the least *how* to study, he went on with the work with those who had suffered no such loss of time.

Something is wrong when such a thing can happen. Here also public opinion must be aroused to the fact that our public school system is not meeting the needs of those preparing for

medical or other professional work. The facts cited by Mr. Bok in the *Outlook* for August 16th, 1913, as an argument that our colleges are failing their mission, was not a criticism of the colleges so much as it was of the preparatory schools. Of 449 replies to Mr. Bok's test letter sent to college graduates of this year, 1913, 44 per cent. only were fair, and 33 per cent. good; the rest failed to receive a pass mark of 70 per cent. If a high school scholar cannot spell or frame an acceptable business letter, the school system that countenances such a state of affairs is a failure. If these things are true, is it any wonder that graduates of high schools are indifferently prepared for the study of medicine and dentistry, which are subjects demanding the capacity to work and to apply one's mind to difficult tasks.

Let me repeat: Is it not more reasonable to try and reform the methods of teaching and the subjects taught in our secondary and high schools? Will a student come to the study of a preliminary year in chemistry, physics and biology any better prepared to think? Why should he not be made to know how to apply his mind before he comes to contend with subjects that are hard for him? Latin, Greek, or modern languages and mathematics have that property; they have served that purpose for many generations and they will continue to serve it if they are given the opportunity.

TECHNIQUE FOR MAKING IMPRESSIONS AND MODELS FOR THE CONSTRUCTION OF ARTIFICIAL DENTURES[1]

BY DR. WILLIAM A. GIFFEN

MR. PRESIDENT AND GENTLEMEN: I appreciate the honor and the privilege of appearing before you to discuss what, to my mind, is the most important subject in the whole field of prosthetic dentistry, viz., the basic principles involved in the construction of artificial dentures.

I have not a great deal that is original to offer, but have arranged in detail into one complete system what, in my judgment, are the best points from the various methods employed by other prosthodontists and which, in my hands, after considerable clinical experience, produce the best results. These I shall present to-night for your consideration. Should I be able to smooth out, for those of you interested, some of the rough places in prosthetic work, I shall feel amply repaid.

To get the best results in artificial dentures there are three steps which require the same accuracy of judgment and manipulation as that exercised in successful inlay or root canal work, and carelessness in any one of the three steps will invite certain failure to a greater or less degree.

The first of these three principal steps is a correct impression; the second, a perfect model that will remain unchanged in shape until the denture has been vulcanized and cooled; the third, a proper arrangement of the teeth.

No man should expect to make artificial dentures that will be practically successful until he has mastered a good technique for these three steps.

The most important part of this technique is the Greene Method of adapting a plastic matrix to obtain a correct impression of the surfaces to be fitted. We shall therefore use the Greene inventions for the purpose of making the work as simple and accurate as possible.

[1] Read before the Section on Prosthetic Dentistry of the First District Dental Society of the State of New York, December 10, 1913.

Preliminary impressions and models of each case should always be made. This takes but a few minutes, and the time will be saved or made up later. This gives an opportunity also to judge the temperament of the patient and his attitude towards the operator, which is very important, especially with referred patients. It also demonstrates to the patient that you are giving the case careful consideration. From the models you can better estimate the difficulties to be met, and you can also fit trays to the preliminary models, which will require the minimum amount of impression material to make a correct impression.

Preliminary upper impressions: Select a Greene Method tray which will easily slip over the ridge, place enough " Perfection Impression Material " in the tray, molding it over the inside so the center will be heaped up, and leaving a slight excess around the rim of the tray; place the tray in the mouth and gently press it to position, and with the finger press the excess up under the cheeks and lip. Take a small gauze sponge wet with cold water and place it against the lingual surface of the tray to chill that portion of the impression, hold this in position and have the patient work the muscles of the cheeks and lip over the soft rim of the impression to show approximately the line of muscular attachment.

The preliminary lower impression should be made in the same way, except that the inside rim should be trimmed to prevent it from pressing against the muscles when the patient sticks the tongue out of the mouth as far as possible, thus allowing the muscles and the tissues of the floor of the mouth to press against the plastic inner rim of the impression.

The preliminary models are made by selecting from the Greene ready-made non-changeable approximate metal models an upper metal model that will approximately fit the upper impression, and a lower metal model that will approximately fit the lower impression. A sufficient amount of plaster to cover the inside of each impression and the ridge of each metal model is now mixed, the upper metal model is gently pressed to position in the upper impression and the lower metal model pressed into the lower impression; and the excess of plaster which has been squeezed out around the edges, wiped off. When the

plaster has set the impressions should be stripped off and the models trimmed,—being careful to leave the shelf portion which clearly defines the edge of the impression.

You now have models, which are about 96 per cent. metal, with a thin film of plaster over them. No model can be made that is less changeable, and they will not warp or break and will stand a great deal of abuse. There is no possibility of squeezing them out of shape by careless packing, flasking or vulcanizing. Also by adding 25 per cent. Portland cement to the plaster, any kind of a metal base plate can be swaged over them perfectly in a rubber block swager. The writer would also suggest at this point that the only safe way to make a cast metal base plate is to make two models for each case, cast the base plate on one model and then swage it over the other model to correct any warping or change in shape which may have taken place during crystallization of the metal.

Trays are now made, for taking correctable impressions, by swaging Ash & Sons No. 7 soft metal over these models in a rubber block swager. The trays should be trimmed a quarter of an inch shorter than the finished plate is to be, and the edge or rim should be only deep enough to prevent slipping. The edges of the trays, while still on the models, are opened about one-eighth of an inch with a knife, and are then taken off the models and a beading traced along the edge with a stick of Perfection Impression Material; a wafer of the same material is warmed and spread over the inner surface of the trays, with the excess folded along the edges of the trays. The models are now coated with vaseline or cocoa butter, so the impression material will not stick to them, the impression material in the tray is softened slightly so it can be changed in shape, and the excess impression material on edges burnished up to muscle line on models with the fingers.

All of this work can be done by your assistant, and when the patient comes you are ready with an approximate correctable impression, which can be easily transformed into an accurately fitting test impression that will be correct in height and length, as the denture should be. It has about an equal strain on the hard and soft parts and relief, without a leak for motion of muscles.

First Step.—Take correctable impression and pass back and

forth over flame from small burner to soften the surface to a semi-flowing consistency, but not quite hot enough to burn your fingers at a touch. Always wet your fingers with warm water, and explain to your patient that it is not hot enough to burn.

Place the tray in position in the mouth and push up lightly. If the roof of the mouth is deep, work the impression slightly forward. When properly seated take a small gauze sponge wet from cracked ice and place it on the lingual surface of the tray, holding it in place for about half a minute; at this time, straighten up the impression material above the edge of the tray all round, but not tightly against the gum, and while the rim of material is still soft, ask the patient to work it down by moving the lips and cheeks. This gives you the approximate height of the impression, and now, with a fresh cold sponge, cool the rim. Now let go of the tray, and if the impression stays in place without any muscular movement to dislodge it, you know it fits the roof and bearing surface of the ridge. This test rarely fails; if it does, repeat the operation of fitting the impression.

Second Step.—When the rim has been trimmed approximately as to height, warm the rim slightly on the outside and with a sharp knife shave off until the rim is about twice as thick as the finished plate rim should be. Next, trim the distal edge of the plate, leaving it about one-eighth of an inch too long.

The finished denture should be long enough to extend slightly into the soft tissues, but not far enough to interfere with muscular action in swallowing. Warm this thin projecting edge until it is quite flexible, place the impression in the mouth quickly, and have the patient swallow once or twice.

Take the impression out and find the distal edge turned down as far as the muscles have moved it, chill in cold water and trim off to where it turns down. Repeat and trim again if necessary. This valve pressure fit should extend clear around the impression behind the tuberosities. If at any point the rim is short, add as much as is necessary with a stick of impression material.

Third Step.—Retest the roof and ridge by pouring a small stream of hot water into the impression and allowing it to run off at the heels. The rim must not be softened, but the center should be as soft as possible without burning the patient. Quickly

insert it and immediately press it lightly and quickly. Repeat as often as necessary until the impression will stand a roof fit test —*i.e.*, hang there snugly with no muscular motion to loosen it.

Fourth Step.—Correct rims to muscles. This is to get the exact height of the plate rim at every point and to get relief for the muscles without a leak. Warm the edge of the rim slightly and pinch it up, making it a little too high and thin at the top; now warm quite soft to a very shallow depth, place in the mouth and with quick, vigorous movements of lip and cheeks work it down to proper height to fit the moving muscles.

I usually do this one side at a time, until every tissue, hard and soft, has cut its way into this very soft rim, over a hard under-stratum.

Frequently this part of the operation has to be repeated and particular points especially warmed where attachments of muscles are stringy, but persistence is sure to bring accurate results.

Unless individual muscle attachments require special attention, you can trim accurately the impression rim in a few minutes. Continue to trim until the natural movements of cheek and lips fail to cut any deeper into the softened edge.

Fifth Step.—In conforming the rim to the buccal and labial surfaces of the ridge, gentle pressure must be used on the soft or compressible areas. These surfaces are always harder in some places than in others. The work must be done very carefully, as it is of utmost importance in many cases.

Slightly warm the rim of the impression extending beyond the edge of the metal tray on the left side by passing it over the flame, slowly warming it through from the outer side until it reaches about the softness of the palm of your hand; slip it into place in the mouth quickly and as quickly place a cold cotton roll between the cheek and the softened rim, hold the impression in position with the right hand and press gently on the outside of the left cheek with the left thumb and hold it for about half a minute, until the cold roll chills the impression material to prevent rebounding when pressure is removed. The rim is conformed to the labial and opposite buccal surface in the same way. In easy cases, where there is a big mouth and thin lips, both sides and the

front can be conformed at the same time. Next, gently warm the heel corners, replace in the mouth, and with cold gauze covering the index finger of right hand gently burnish around the tuberosities.

Sixth Step.—Conforming the distal edge of the impression, the most important point for adjustment in the entire operation, slightly warm the edge projecting beyond the edge of the metal tray, place in position in the mouth and instruct the patient to press it up gently but firmly at the back part with the tongue and hold it for a minute, then finish and cool with finger pressure.

In practice as many of these details may be united as the case and the ability of the operator will permit. However, there is seldom any necessity for being in a hurry, the operation is not objectionable to the patient, and in most cases the patient is as much interested as the operator. I would add that few patients will ever feel satisfied that their impressions are properly made subsequently, unless the same care is used.

Final Test.—The finished impression is placed in the mouth and the patient is instructed to try to loosen it by moving the muscles of the lips and cheeks, or swallowing, or biting on the finger. If none of these movements throw the impression down, a plate properly made from it will not be loosened. However, if some of these movements loosen the impression, do not hesitate to readjust the part where loosening first takes place. If you do not correct it at this time, the alternative will probably be to remake the denture.

Lower Dentures.—The first requirement is a preliminary impression and model upon which to swage a tray that will fit the crest of the ridge and about one-quarter of an inch shorter than the denture should be. The same principles should be followed as in the upper impressions.

The outer rim and heels are trimmed to allow swallowing and lip and cheek movement. In trimming the lingual edge for the soft tissues of the floor of the mouth, the edge must be warmed until it is very soft and the instant it is slipped into the mouth, the patient must bite down on the rests, swallow, and move the tongue all over the roof of mouth as vigorously as possible. The impression is then cooled and the excess material

trimmed off with a knife, and the operation is repeated until there is no more excess to turn up.

Now conform to lingual surface of ridge by warming until it is quite flexible, and have patient press steadily with the tongue for a minute and finish with cold finger pressure, but don't bear hard nor press downward when retouching.

Test for Fit.—The impression is thoroughly chilled, placed in the mouth, pressed down with index fingers for about a minute; if it sticks fast, or even if it comes loose with a little noise, it is correct. If not, alter it where it is strained up first. The denture made from such an impression will always test better after it has become properly seated.

Final models are now made in the tested impressions exactly as the preliminary models were made.

The impressions pulled off and the metal trays cleaned and re-swaged to the models, they are now known as bite plates, upon which, build rims of base plate wax. The metal bite plates have many advantages. They fit as accurately as the finished plate will fit; the heat of the mouth will not cause them to soften and bend out of shape; they will stay in position; they require the minimum amount of wax to take the bite; the patient will not object or become impatient while you are building on or trimming for feature restoration.

When the bite has been taken and the face bow attached, they are taken out of the mouth and placed on the models and the models attached to articulator. After the condyle path has been established, and the median and lip line marked, they are ready for placing the teeth by simply cutting out the wax rims in sections as the teeth are set up. The metal bite plates take the place of the wax base plates. This is also of great advantage; they protect the models from getting daubed up with hot wax; they are exactly the same thickness that the roof of the finished plate is to be, and the surface shows any ridges or irregularities the roof of the mouth may have. Consequently the plate will have a more natural feeling to the tongue. The plate will require the minimum amount of polishing, and will have the maximum amount of strength in the roof of the plate with the minimum amount of rubber.

REPORTS OF SOCIETY MEETINGS

FIRST DISTRICT DENTAL SOCIETY OF THE STATE OF NEW YORK

March 19, 1914.

A special meeting of the First District Dental Society, S. N. Y., was held in the amphitheatre of the New York College of Dentistry, No. 205 East Twenty-third Street, New York, on Thursday evening, March 19, 1914.

The president, Dr. H. W. Gillett, occupied the chair and called the meeting to order. Professor Dr. Guido Fischer, Professor of Oral Surgery in the Dental Department of the University of Marburg, Germany, presented the paper of the evening, entitled "Local Anesthesia."[1]

[The paper was followed by a number of lantern slides, Dr. Fischer's description of which was translated by Dr. Reithmüller. Then followed a demonstration, by moving picture, of several operations, showing technique of injection, etc.]

Discussion on Dr. Fischer's Paper.

Dr. H. S. Vaughan—I think we are most fortunate in having Dr. Fischer with us this evening. I have been interested in the subject of local anesthesia for nearly ten years. My first work was with the substitutes for cocaine, such as eucaine, alypin and acoin, etc., but I found them all entirely too irritating when injected locally. Later I took up the work with cocaine. We were in the habit of using one and two per cent. solutions, but I found that by cutting the solution down to one-half per cent., in the majority of cases it could be used very successfully; but there was still the question of individual idiosyncracy. In these cases we never knew when collapse would occur, so that following the work of Dr. W. S. Schley, of this city, who has obtained such excellent results with novocain in general surgery, I took up the use of this drug, and can heartily endorse everything Dr. Fischer has to say about it.

[1] See Dr. Fischer's paper in full at p. 411 of the present issue of THE JOURNAL.

In my early solutions of cocaine I used suprarenin in about the same proportion as we do at the present time. Suprarenal extract is as important in the solution as the novocain. A word of caution, I think, should be sounded in the use of suprarenin. The tendency has always been to use too strong solutions. When the first novocain tablets were put out they contained one two-hundredth of a grain of adrenalin to one-third of a grain of novocain, sufficient for one injection. I found in using them in cases of arterio-sclerosis, where there was high arterial tension, that considerable precordial pain, and often faintness, ensued; symptoms that did not occur with novocain alone. I think it is entirely due to the suprarenin producing rapid heart stimulation.

In the preparation of the solution later on, I had capsules prepared containing a definite amount of novocain with the sodium chloride to make a normal salt solution, and to that I would add the suprarenin. Of late we have the excellent tablets put out by the Farbwerke-Hoechst Company, so that we can make up our solutions fresh. My own plan is to make them up fresh daily. I think it is always wise, even when using the synthetic suprarenin, not to boil it too much, even though it is a synthetic compound. I prefer to boil my novocain solution and then add the suprarenal extract, the proportion being about ten drops of the suprarenin solution to ten C. C. of the novocain sodium chloride solution.

Regarding the syringes and technique of injection, I can endorse everything Dr. Fischer has said. I think the manufacturers of instruments in this country have been backward in providing us with suitable syringes and needles. The ordinary syringe that is on the market, of the Imperial or Parke-Davis type, has always had a leather washer, and these syringes cannot be boiled without putting in new washers every time; but a very simple plan is to take one of these syringes, throw away the leather washer, and substitute one of asbestos twine. Wind the piston with it. Such a syringe can be boiled without any detriment whatever.

In the matter of needles, the average so-called dental hypodermic needle is entirely too short to be of much value. During the past year I have been getting the German needles such as

Dr. Fischer suggests. Other than that I have used the regular hypodermic needle; that is, a needle about an inch long. For a time one of the supply houses turned out a needle about half an inch in length, 28 gauge, which was very good; but I understand they are not manufactured now.

In my work I can endorse everything Dr. Fischer has said. In our class in oral surgery this winter, the members can certify that we have been able to get splendid results. We have operated in cases of empyema of the antrum, opening up large abscesses, removing cysts, impacted teeth, and all with perfect results as far as the anesthesia is concerned.

Novocain suprarenin is of special value in the case of broken-off roots, etc. We can do a very careful operation in a relatively bloodless field, and in that way there is not the amount of tissue laceration, and we get much more rapid healing.

In the matter of technique, I think our best results, as far as the mandible is concerned, are by conductive anesthesia, while in the maxillary we can depend to a great extent on sub-mucous infiltration, supplemented by injecting the various nerves at their foramina; that is, by conductive anesthesia.

One point that has not been touched upon is in the case of conservative dentistry, namely, in injecting novocain for dentinal anesthesia by sub-periostial injection, both labial and lingual. In many jaws, particularly in the maxilla, the bone is more spongy, particularly in the interproximal spaces, and thus a fine needle can be inserted at the base of the gum festoon and worked into the interproximal space directly into a small foramina, and thus obtain intraosseous injection, securing anesthesia of a given tooth often much more readily than by sub-periostial injection alone.

Dr. H. S. Dunning—I appreciate greatly the honor that has been conferred upon me by the First District Dental Society in making me chairman of the Oral Surgery Section this year, and in giving me an opportunity of working with, and entertaining our distinguished guest, Dr. Guido Fischer, of Germany.

I have had the pleasure of working with Dr. Fischer all this afternoon in the Oral Surgery Clinic, and feel that we have with us a man who is a past-master in the technique of local anesthesia, and one who is also a very skillful surgeon.

I have listened to his paper with great pleasure to-night, for local anesthesia is a subject which has interested me for years, and is a form of anesthesia that we have been using here at the college since about 1908. Novocain was brought to this country, from Germany, first, I believe, in 1906, by my old friend Dr. Winfield Scott Schley, of St. Luke's Hospital. He has written many articles upon local anesthesia in surgery. His first paper on novocain appeared in the *New York State Journal of Medicine*, December, 1907. This paper was written after Dr. Schley had done considerable experimental work in this field on dogs, and had proved conclusively that novocain was about seven times less toxic than cocaine. In 1908-09, after Dr. Schley had been performing major surgical operations—appendectomies, hernias, amputations, etc.—under novocain, he gave a demonstration of his technique at this college, and I had the pleasure of removing successfully several impacted teeth, and excavating some sensitive cavities, under complete anesthesia produced by him with novocain. Since this demonstration of his, my assistants and myself have been using novocain daily at the clinic here, and our bills for nitrous oxide and oxygen have become insignificant.

There is very little that I can add to Dr. Fischer's paper. I agree with him that almost every operation of the mouth and jaws can be performed under local anesthesia, and that many operations that are made difficult under a general anesthetic can be made quite simple under a local anesthesia; for example, difficult third molar extractions and root amputations. Any one in this audience who has attempted to remove a badly impacted third molar in his office, under nitrous oxide and oxygen, where careful bone cutting is required, appreciates what he is up against at times, with great increase of hemorrhage, increase in flow of mucous, causing choking and retching, and sometimes the muscular spasms and struggling of a nervous or alcoholic patient who does not take nitrous oxide well. Without novocain, a great many of these operations necessarily become hospital cases, with all the post-operative nausea, inconvenience and delay to the patient.

During the last six years my assistants and myself have performed, at our daily clinic, between 3,500 and 4,000 minor

surgical operations under novocain. These operations have included simple extractions, removal of impacted and non-erupted teeth, excisions of epuli and tumors of jaws, removal of cysts, curetage of necrosed bone, and opening abscesses, root amputation, removal of infected glands, etc. These operations have been performed under anesthesia by the infiltration and also by the conductive method, and the results have been very satisfactory.

In closing, I want to thank Dr. Fischer for the delightful and instructive evening he has given us, and to wish him a most pleasant visit to this country.

Dr. Theodor Blum—It is a matter of great pleasure to be here this evening and listen to Dr. Fischer's very valuable paper. It was indeed what we call a treat, and I hope this is only the first step the First District Dental Society is taking, in inviting some of the good men from abroad. We have to thank Dr. W. D. Tracy for getting Dr. Fischer over here.

With the method of conductive anesthesia we have advanced a great deal. Whereas in former days minor oral surgery in this country was on quite a low basis, because nitrous oxide and oxygen was used, under which anesthesia it is impossible to do perfect work. Since the introduction of this new method of anesthesia we have arrived at quite a different standard, to a field of operation comparatively bloodless. The operator can take his time without lacerating the tissues, and the patient himself is certainly more comfortable and is better off generally.

I prefer a different syringe to the one Professor Fischer recommends, on account of its smaller size [2]; but I think it is less the instrument than the hand of the operator, which has to decide upon just which is most handy to him. I am still using the steel needles; the finer needle for all injections except the mandibular.

I have to differ with Professor Fischer and some of the men who discussed his paper, as far as conductive anesthesia in the upper jaw is concerned. I have used it very frequently, and I can show you on my hospital records that we are using conductive anesthesia in the upper jaw more frequently day by day.

[2] The syringe referred to is illustrated in an article entitled "Local Anesthesia," by Dr. Blum, and published in "Items of Interest," March, 1914, page 187.

It is a very simple method, and really easier to get used to and learn than the mandibular anesthesia, which I consider the most difficult one. Even for ordinary extractions in the upper jaw, I frequently resort to conductive anesthesia. The men working with me at the Fifty-seventh Street Hospital have easily learned this method, and it is very satisfactory, whereas the ordinary infiltration method is not only more painful, but there is more chance of infection, because we have to inject and pierce the mucous membrane repeatedly.

Now to come to the lower jaw, which I have to dwell upon a little. The mandibular anesthesia is really the most remarkable anesthesia we have.

In the last number of the *Items of Interest* there is an article by Dr. G. S. Marshall which you should all read.

I want to refer to the way Dr. Marshall writes his paper. He is very unfair in calling Professor Fischer's statements incorrect, misleading and dangerous. He gives his own history, saying he is sixty-seven years old and in perfect health, except for two molar teeth which have gouty tendencies. If a man sixty-seven years old has gouty tendencies, I draw the conclusion that he has gout, and therefore is not in perfect health.

He states: " His teeth have been treated frequently since his return from the Philippines by expert specialists, that suppuration has never been controlled nor the disease checked. Constitutional treatment and restricted diet have made no impression upon the disease."

The method used here was the peridental method. Whether Dr. Marshall means the injection into the peridental membrane or infiltration, anesthesia is really immaterial. He has pyorrhoea, and he says in addition that a large abscess between the roots of the first and second molar has formed, and this root was perforated and filled with zinc-chloride. Taking all these different facts into consideration, we must say that mandibular anesthesia *only* was indicated in his case.

There were four tablets of novocain of the Parke-Davis Company used. I object to these tablets, for they are soft tablets and make the operator very careless. They dissolve quickly in a cold solution, whereas if you use the Farbwerke-Hoechst tablet

you have to throw them into a boiling solution, and keep the solution boiling for a few minutes to hasten the dissolution: all this insures a sterile solution to work with.

To come back to his case again, Dr. Marshall says that two grains of novocain were used, but at least one-half was lost through leakage around the loosened teeth, which shows that the specialist injected into the pyorrheal pockets, causing the pus to go into the tissues again: all the symptoms mentioned were probably due to the absorption of septic material. The symptoms which immediately followed the injections I attribute to the adrenalin.

You still have in novocain a very good, probably at the present time the best, anesthetic, and I think Dr. Marshall was rather quick in making the statements in the article mentioned.

Dr. M. I. Schamberg—It is quite unnecessary for me to lay stress upon the importance or value of this contribution that you have listened to this evening. I know of no paper that will record such usefulness to the dental profession of this country as the very lucid description that Dr. Fischer has given us this evening of local anesthesia as it is scientifically applied. We know that for many years local anesthesia has been used in dentistry, but it has been used with a good bit of condemnation. No practice has been so severely criticised by the observant oral surgeons of this country as the use of local anesthesia about the mouth, owing to the frequency with which necrotic processes have been stirred up, if not actually produced, by the injection of various preparations.

To-day we have an ideal, or as nearly ideal local anesthetic combinations as can be reasonably found, and the description of which preparations you have heard this evening. Some five years ago, when I spent a little time in Berlin on my way to the International Medical Congress at Budapest, I had the pleasure of witnessing some of these operations done under local anesthesia, and some of them done under partial attempts at conductive anesthesia. I do not believe that in those days conductive anesthesia was brought up to the point of full usefulness that it is to-day, but with the improved technique we now have a means of performing, not alone minor operations about the

jaws, but major operations entailing even the exsection of the superior maxilla, or even of the half or full lower mandible.

Within the past year—and I want to give credit this moment to my assistant, Dr. Blum, who came back from Europe a little over a year ago with the technique perfected—I have utilized this anesthesia with very gratifying results in operations that formerly I would not think of conducting except under complete general anesthesia. These operations are conducted with greater ease, and certainly with less annoyance to the patient. We know how frequently patients object to hospital operations, and it renders an office operation possible where formerly they had to undergo an operation in the hospital under general anesthetics.

I do not propose to discuss Dr. Fischer's paper, as I am sure he is far better able to tell you the technique and the advantages of this method than I—but I want to merely give clinical evidence with about four or five slides to the value of this work in oral surgery. I have also asked one or two patients that I have operated upon within the past few years, to be here this evening, so that you might see in large cysts of the jaw where it is necessary for me to cut away a large amount of bone, in direct communication with some of the important nerves of the face, that we produced an anesthesia that was ideal for our work. These patients are here, and after the lecture any of those of you who are specially interested may have an opportunity of examining these wounds to determine the extent of the operations possible under this ideal means of anesthesia.

(Dr. Schamberg showed slides, and the patients referred to were present for examination.)

Adjournment.

FREDERICK C. KEMPLE, D.D.S.,
Editor, First District Dental Society.

THE BOSTON AND TUFTS DENTAL ALUMNI ASSOCIATION

June 13, 1914.

The annual meeting of the Boston and Tufts Dental Alumni Association was held at Tufts College Chapel, Tufts College, Boston, Saturday, June 13, 1914. This meeting was held in conjunction with the other alumni departments of Tufts College and proved to be a most enjoyable occasion. The result of the ballot at the business meeting held in Goddard Chapel at 6 p.m. resulted as follows:

President, Dr. J. L. Taylor.

First Vice-President, Dr. E. L. Morse.

Second Vice-President, Dr. J. Herman Haines.

Treasurer, Dr. Geo. W. Payne.

Secretary, Dr. Anne S. Worthen.

Executive Board: Dr. A. G. Richburg, chairman; Dr. F. A. Sawyer, Dr. E. U. Ufford, Dr. P. A. Barton.

The programme for the day started with registration at Ballou Hall. After this interesting formality had been concluded, all hands wended their way to the athletic field and had the pleasure and edification of seeing the strong Tufts team administer a defeat to their opponents from Brown University.

The banquet held in the Gymnasium was enjoyed by all, and interesting addresses were given by various members of the faculty, trustees and prominent alumni.

A. G. Richburg,
Editor B. & T. Dental A. A.

THE JOURNAL OF THE ALLIED DENTAL SOCIETIES

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S. ELLSWORTH DAVENPORT, JR., D.M.D., *Associate Editor*
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VOL. IX NEW YORK, SEPTEMBER, 1914 No. 3

EDITORIAL DEPARTMENT

A UNIVERSITY COURSE OF "RESEARCH IN DENTAL CHEMISTRY"

Among the impressive signs of progress in recent years is the growing realization that the biochemical problems underlying dental and oral diseases are of such intricate nature as to call for the best scientific facilities available at the present day. The well mean-

ing and self-sacrificing practitioner-investigator in this abstruse and highly specialized field is rapidly becoming an anomaly. The time was when he led the way, because his aspirations and hard work over and above his office duties enabled him to penetrate superficially the then wholly unknown region of speculation and, by so much, aid the gropings of less ambitious fellow practitioners. All that was then within reach could be grasped by the man's left hand, so to speak, leaving his "working hand" for the practical affairs of the day's work.

In the course of the last twenty years our literature has become permeated with a mass of ill-considered, half-digested, and therefore wholly misleading deductions, drawn from imperfect premises, which for want of better light our dental educators have adopted in college curricula, and so transmitted to thousands of graduates. These graduates, in later activities before dental societies, in writing or discussing papers, proceed naturally upon the "fundamentals" which they have accepted as beyond criticism, and so find themselves and others walking in circles, from the hypnotic circumferences of which there seems to be no escape.

Error begets error more swiftly than rabbits breed. The man at the test tube who allows to escape one uncertified statement, one unjustified inference, may be responsible for trouble of such vitality as to become his lasting monument. Hence the supreme importance

of accuracy in the search for facts in a field on which of necessity very few men are qualified to enter. The thousands who apply the knowledge there found must rely upon the expert testimony, and every test of reason must satisfy them of the qualifications of those experts.

The realization of the present imperfect state of our knowledge, and of the imperative demand for revision, from the undermost foundations, has become so compelling of late as to bring into being the Scientific Foundation and Research Commission of the National Dental Association.[1] This Commission is now engaged in a nation-wide campaign of raising a fund sufficient to carry forward the work of expert investigators in many lines of inquiry.

A further and very significant evidence of this scientific awakening over problems related to the teeth and mouth is the inauguration in Columbia University of a course of "Research in Dental Chemistry" of such academic value as to count toward the requirements for the degree of Ph.D. This is, so far as we know, the first and only university course of its kind. The students electing this course work under the personal supervision of William J. Gies, Professor of Biological Chemistry of the College of Physicians and

[1] The Executive Board of this Commission consists of twenty-five of our best executives and investigators, chosen, for their fitness, from all parts of the United States, under the leadership of that self-sacrificing worker, Dr. Weston A. Price, of Cleveland. A review of recent activities of this body will be given in an early issue of THE JOURNAL.

Surgeons, and the report of the work of the first class, performed during the past summer, is given as the leading paper in this issue of THE JOURNAL.

This paper comprises sixteen distinct items of original work, each item being the report of the individual who performed the experiments and researches outlined therein. The careful reader will note from first to last the thorough and painstaking supervision of Professor Gies, who has collated the reports and to whom dental science owes a rapidly increasing debt of gratitude. Our readers are familiar with previous work of Professor Gies; with his immense capacity for accurate observation, his ability to correlate and to present clearly his findings; and last—which is indeed a rare gift—his bold and resourceful initiative in grappling with new problems, or in devising improved means of attacking old ones. Such work is what we need above all things: many lines of attack, each well planned; the collection of great numbers of facts, later to be correlated; the work of many hands, guided by one of powerful originality: a combination of forces which should make history in any endeavor.

In writing the Editor, Doctor Gies states: "We made a very modest beginning, but, I believe, can expand the course to fine proportions, and can make it a source of new and effective results annually." This is a modest statement, in view of what has been already accomplished, and of future possibilities. The personal enthusiasm which created such a course in scien-

tific study, backed by the facilities of Columbia University, should result in important advancements in our knowledge of the causes underlying dental disease.

AN APPEAL TO FOUND A DENTAL LIBRARY

The urgent request has been received from Professor Gies that THE JOURNAL appeal to its readers for help towards the foundation of a dental library—an appeal not for cash, let us say at once, but for books and journals. In connection with his researches now going forward under the auspices of the First District Dental Society, Professor Gies is preparing an extended review of the literature on dental caries, for publication in book form, and his immediate need is that of access to original material—the greatest amount obtainable—from all possible sources. He asks for the gift *or the loan* of books, journals, pamphlets, reprints, letters—any recorded dental information—whether ancient or modern. Loaned material would be carefully handled and duly returned; gifts would form the nucleus for a permanent dental library, in his charge, for the use of the Columbia University Medical School, to which the access of dental practitioners and students would be welcomed. This should serve as a stimulus for Columbia to develop systematically such a library.

THE JOURNAL heartily seconds this appeal. The simple fact is evident that Columbia University is becoming the center of such activity in dental research as to command the attention, appreciation and generous

support of the dental profession throughout the world. There is no fitter place for the establishment of a fine working library. Strangely enough, it is difficult to point to anything of the kind in this or other countries. The advanced student is thus balked at the outset in his researches. A science without its classified literature is almost a contradiction in terms; and this is not a creditable reflection as touching a great branch of medicine.

We appeal to all readers to search their private collections for what can be spared, and to forward such budgets to Prof. William J. Gies, 437 West Fifty-ninth Street, New York City. They will be duly acknowledged and put to the best use.

A CORRECTION: ACKNOWLEDGMENT TO DR. HARTZELL

Through an unfortunate typographical error, the words "subsequently died," in the paragraph beginning with the word "Larson" (p. 173, June issue of THE JOURNAL), were so transposed as to make the meaning apply to Dr. Larson, instead of the patient to whom the comment refers. The Editor sincerely regrets this mischance, and offers his apologies to Dr. Hartzell, and especially to Dr. Larson, for the very unfortunate impression conveyed in the paragraph as printed. The correct version follows:

"Larson, in his brilliant work on the fusiform bacillus isolated coincidentally both from the blood stream and from a lesion around human teeth of an individual who subsequently died, has been able to cause the fusibacillus to develop typical spirilli and again relapse into the fusiform bacillus, illustrating in an impressive way these possibilities of transmutation."

CORRESPONDENCE

New York City, August 19, 1914.

Dear Doctor Dunning: I should like to call your attention to a part of Dr. Hartzell's very interesting paper,[1] in which there is latitude for a difference of opinion. He states "As early as 1887 Alfred *Mantle*, of England, pointed out the relationship between the tonsil and rheumatic fever." It is my personal opinion, after having read Mantle's original paper, that the more important fact is that Mantle demonstrated rheumatic fever to be an infectious disease, due to a bacterial invasion. Further, I should like to call your attention to Mantle's article in the *Practitioner* January, 1912, in which he states:

"I was first impressed by the marked rheumatic symptoms which I witnessed occur in those affected in an epidemic of infectious sore throat, which I brought before the meeting of the British Medical Association at Cardiff, 1887; also the frequency of rheumatic symptoms in scarlatina, which I discussed in the *Quarterly Medical Journal.* In one instance I saw several adult members of a family affected with scarlatina, who, but for presence of the scarlatina rash, would have passed for sufferers from rheumatic fever. These observations at least, suggested that the throat joints and serous membranes became affected during a bacterial invasion, and the possibility of acute rheumatism itself having a like origin. Two epidemics of rheumatic fever, which I also witnessed, pointed strongly to infection, as did the fact of more than one person in the same house in two instances becoming affected at the same time."

At the conclusion of the same article, he states: "One word more about rheumatoid arthritis and its relationship to acute rheumatism. Personally, I think there is little or no connection between the two conditions, and in a case of rheumatoid arthritis

[1] See June issue of The Journal, p. 166.

supposed to be a continuation of acute rheumatism, we have, I believe, an example of a second infection developing in a subject weakened by antecedent attacks of rheumatism. Rheumatoid arthritis is, I consider, associated most commonly with a toxemic condition, frequently of gastro-intestinal origin, and most commonly it is found in connection with constipation and colon catarrh. But in all cases, pyorrhœa alveolaris, another cause, must be excluded, and any source of sepsis, particularly of the nose and throat."

Sincerely and fraternally yours,

Alonzo M. Nodine.

NOTES ON PRACTICE

COMPILED BY WILLIAM D. TRACY, D.D.S.

Limiting Gas-oxygen Analgesia. — The question now arises, why all this discussion, if nitrous oxid is capable of producing true analgesia and is absolutely safe? There can be no discussion of this point if we limit the use of this gas to the easing of pain alone. It is when we try to do more that we are doomed to failure. The sound of the bur, for instance, cannot be entirely eliminated, short of general anesthesia, and where this sensation is particularly unpleasant nitrous oxid analgesia will not always be a total success. The sense of touch, or the knowledge that something is being done, is also retained.—MOSES SALZER, *Dental Register.*

Orthodontia Notes.—In conclusion, let me sum up briefly as follows:

Under normal conditions of growth, a definite relationship exists between the size of the teeth and the jaws, allowing for variation in the length due to the correlation existing between the head and the length of the jaw. The greatest variation is in the width of the ascending ramus.

The deviation from normal is connected, as a rule, rather with the alveolar process and the teeth than with the entire mandible.

No prearranged diagrams or forms can be of use to us, in that we must observe the correlation which exists between the form and position of the teeth, the form and position of the dental arch, and the cranial type.

The normal arrangement in the jaws is the result of normal growth of the bone. Normal denture lines accompany normal facial lines, and abnormal arches must give a certain degree of abnormality to the line of the face.

We must study the relation of the normal arches and features in models taken from living individuals as well as in skulls and their measurements, in order to obtain results.

More attention must be paid to the difference of the four forms of the dental arch and the difference in types.

Although a tooth has a normal position, this position changes from day to day, and in the same relative proportions the normal occlusion is influenced.

In the examination of models of normal arches, it is found that the two sides are not symmetrical, and that certain teeth deviate from perfect regularity.

"To establish normal arches and occlusion and retain the teeth in their normal position, to maintain the balance and harmony that must exist, the full complement of the teeth is necessary."

The orthodontist should always remember that there is a definite correlation between normal arches and occlusion, and bear in mind the design of nature—viz., beautiful occlusion, graceful lines, and magnificent architecture.—B. W. WEINBERGER, *Dental Cosmos.*

Service Required of Normal Teeth.—I would like to call your attention to the amount of service required of natural teeth. They are expected to prepare perfectly three meals each twenty-four hours, an act that takes from 800 to 3,000 triturations or closures each meal, according to size of meal, occupation or environment of the individual. Now, to properly chew food, especially meat, the trituration will be from forty to sixty times for each morsel or bite, and the stress exerted will be from ten to fifty pounds or more, according to individual habits. Calculation will give number of closures and the great amount of service required at the year's end, which is perfectly natural, and is performed regularly as all other functions are performed, without a feeling of discomfort so long as they are in good health and a normal condition. —W. O. HULICK, *Dental Summary.*

Porcelain Contours.—If we find our porcelain contour restorations of the anterior teeth beginning to strike the lower teeth and we grind them down until they do not touch, as soon as the remaining teeth wear down a little more or the molars tilt over a little farther and allow the porcelain to strike first, it is certain that these restorations become dislodged again; but if we correct the occlusion and prevent the porcelain edges from undue stress, and if we destroy the

micro-organisms that are in the tubuli of the teeth, then so shape the filling that its anchorage by cement is most augmented, and manipulate our cement so that its utmost efficiency is obtained, we are able to secure more permanent results by this method of restoring the anterior teeth than by going about it with no formulated plan of procedure.—J. J. MOFFITT, *Dental Cosmos.*

Cavity Impressions.—If a blunt cone of compound is forced into a cervical cavity, the gum, instead of being forced away from the margin of the cavity, is usually bent over on to the margin and into the cavity and the margin not exposed to the modeling compound will not be outlined in the impression. By using a cone of compound as fine as a lead pencil point and softening quickly for about a quarter of an inch from the end, if inserted quickly to the center of the cavity, will strike the floor of the cavity and spread in all directions toward the walls, running under the overhanging gum and beyond the edge of the cavity. After the first thrust of this fine point into the cavity the bulk of the cone may be firmly pressed against the gum with no fear of it not being displaced from the cavity as well as the margin.

After an impression has been secured, it is wise to drop it immediately into a small glass of cool water, so that if it stands in the laboratory before being packed, it will not be exposed to any undue heat, as an overly-warm room or a draft from a Bunsen burner, which would likely change its form or dull its sharp lines.—E. B. SPALDING, *Dental Register.*

Unnecessary Inlays.—Where an inlay is obviously indicated, we should not hesitate to use it; but we should not recommend it, even to our wealthiest patient, when our judgment points strongly to the belief that we would accomplish more valuable service with the simpler and less expensive filling, no matter whether of gold, of tin and gold, or of the homely and much berated amalgam. In short, we should not recommend to others any service which we would not freely accept, under like conditions, for ourselves, or render for our own children; for he who does otherwise for the sake of added gain, no matter how great his skill or how wide his popular-

ity, is treading dangerously near to the borderland of charlatanism.—A. W. SWEENY, *Dental Cosmos.*

Impression Materials.—The selection of an impression material is a very much debated point at the present time. Some consider that no impression should be taken in anything other than plaster of paris. Others take the stand in defense of modeling compound; there is good reason to believe both have their fields of usefulness. The writer has always placed his dependence upon plaster, and has found that it is not as stable as he could wish. That the Greene method of taking modeling compound impressions of edentulous cases, using the Kerr impression trays and allowing the tissues of the mouth to assume their natural positions during the operation of the taking of the impression is a good one, the writer is assured by the comparatively few tests made thus far. Yet plaster still has a wide field of usefulness, especially in partial cases, where the truest results may be obtained, if care be used.—ELLISON HILLYER, *Dominion Journal.*

Dentinal Changes in Devitalized Teeth.—The physiologic function of the dentinal fibrils seems to be the maintenance of the quality and integrity of the dentin. Clinical experience has taught us that the dentin of pulpless teeth undergoes marked changes. It becomes more brittle and loses much of its strength, elasticity, and translucency and the removal of enamel becomes much more simple. These same changes at times occur in vital teeth, where there has been marked abrasion. In these cases the deposit of secondary dentin probably obliterates the connection of the fibrils with their odontoblasts and the wearing away of the incisal or occlusal surfaces exposes the dentin, and permits these changes to occur rapidly because of the invasion of saliva or extraneous material. This change or deterioration in dentin, after pulp removal, occurs much less rapidly in teeth that have been so treated and filled that no septic matter, saliva, or decomposable material has reached the dentin.

Thus we see that these dentinal fibrils do exercise a physiologic function in the maintenance of the quality of the dentin. How this is actually accomplished we do not know,

but we do know that a destruction of the vitality of the dentinal fibrils produces marked physical changes in the tissue.—W. C. STILLSON, *Dental Summary.*

The Mouth as Danger Center.—While as yet we are ignorant of many facts, evidence is fast accumulating which points to the mouth as, perhaps, the most important center of infection and disease within the human body. With the growth of this idea, the profession of dentistry suddenly appears in a new role. Instead of being of subsidiary importance, it appears to be of primary importance, and instead of being a calling wherein only mechanical skill and ingenuity are required, it appears to be a profession requiring deep scientific knowledge, not only of the human body and its processes, but of organic and physical chemistry and physics.

There are scarcely any dentists or dental students who realized this fact when they began the study of dentistry. And up to the present time there has been so little appreciation of the tremendous responsibility for human life and welfare which rests upon the shoulders of the dentist, that dental schools have not yet been able to extend their curricula to include such medical teaching as will fully enlighten the student as to the injurious and far-reaching effects of poor dental work.—E. H. BAKER, *Dental Review.*

Carved Amalgam Fillings.—If the anatomical carving of the wax model and its reproduction in the gold inlay have aroused enthusiasm and been deemed necessary, how much more important it is to do the same in that filling material which is used so much more in the average practice than any other material. In many cases amalgam can be more advantageously used than a gold inlay, and we should not hesitate to spend as much time and care in doing one kind of work as the other.

Even in a practice where the small fees obtained make it seem prohibitive, if an amalgam filling of this sort be inserted and properly polished in mouths where otherwise we so often find only the dark, rough blocks of metal masquerading as amalgam fillings, many patients will doubtless be grateful and be willing to pay for the difference. After all, it

takes such little additional time to make these restorations properly, and they afford so much satisfaction to the ethical and self-respecting practitioner, that this must surely become the accepted method of the future.—M. J. WAAS, *Dental Cosmos.*

Growth in Dentin.—The line of demarcation between primary and secondary dentin is by no means distinct, nor is it easy to define primary and secondary dentin. The dentin formed during the period of tooth development may be called primary and that formed later, due to some outside stimulation, secondary dentin. We may say that each successive formation of secondary dentin becomes less perfect, the tubules smaller, less numerous, and more irregular until finally a calcified matrix containing no tubules is deposited. In the formation of primary dentin, apparently all of the odontoblasts participate; with each successive formation of secondary dentin, less and less of these formative cells take part. Gradually the communication between the pulp and dentin matrix is reduced and finally almost obliterated.—W. C. STILLSON, *Dental Summary.*

Common Sense in Dental Education.—Dental schools are teaching medicine in so far as it is applicable to the specialty of dentistry, and the line of advance will be to improve and expand the medical ideals of dental teaching. The expectation that the highest efficiency in dental education and practice may be attained through the training afforded by the conventional medical curriculum is a futile one, because in brief terms the medical curriculum does not fit the demands of efficient dental practice. Nor can it be made to do so, for the self-evident reason that the trend of all educational curricula is toward adaptation to special ends, mainly utilitarian, and the medical curriculum will constantly evolve toward the ideal of making better physicians, while that of dentistry will develop toward making more efficient dentists—utilizing for that purpose all of the resources of medical science and art that are adaptable to its purposes.

The rescinding of the dental statute of Virginia is significant of the practical unsoundness of the principle of mak-

ing dentists through the agency of the medical curriculum.—E. C. KIRK, *Dental Register.*

Normal Stimuli in Bone Growth.—Professor Cope is our authority for the statement that bone is formed and molded into shape as a result of mechanical stimulation. If we remove the normal stimuli in children at an early age when the teeth are forming and taking their position by allowing them soft food instead of hard foods, can you be surprised if the bones of the face fail to develop normally? Proof of this is the almost entire lack of malocclusion in the lower animals; and to this reason if no other we can attribute almost all malocclusion in man.—F. STATHERS, *Dental Summary.*

To Twist Cotton on a Smooth Broach.—There is one point in technique with reference to the treatment of pulp canals which I learned on a trip to New Orleans, a point I consider well worth the expense of the trip a great many times over. It had been my custom to dry pulp canals by twisting cotton fiber upon a spiral broach. Occasionally it was almost impossible to get the cotton off of the broach, consequently I lost much time. I tried many times to use a smooth broach as an applicator for medicaments, by twisting cotton upon the broach, but I could not get it to hold. For instance, when I wished to apply a drug in the canals and pump it down toward the ends of the roots the cotton would become loosened. It is an easy matter to attach cotton to a smooth broach, and all there is to it is to draw the smooth broach across a piece of sterile beeswax before twisting the fiber upon the broach. Any amount of cotton may be firmly attached to the broach, and it will not become loosened in pumping the drug into the canals. That little point in technique has saved many hours of time for me. It has materially assisted me in drying canals because I am enabled to use a smooth broach of extremely small diameter and twist a few, or as many fibers as necessary, upon it, and come more nearly approaching the apex of the roots with the dry cotton fibers in drying the canals, than by any other method.—CARL D. LUCAS, *Dental Review.*

Danger in Use of Nitrous Oxid.—I do not believe that

any physico-chemical changes take place within the brain or nerve cells as a result of the inhalation of nitrous oxid; but it produces anesthesia by a deoxygenation process, beginning back in the pulmonary circulation, where, owing to the supply of oxygen being cut off, the venous blood of the pulmonary artery passes unchanged into the minute radicles of the pulmonary veins; but as the latter require oxygenated blood to stimulate them more or less, stagnation ensues, which results in a general anoxemic condition that may quickly develop into asphyxia unless much skill is used in the proper mixing of the gases and a much closer watch kept over the respiration and pulse than is necessary when using ether.—W. I. JONES, *Dental Summary.*

Teaching Importance of Mouth Cleanliness.—No conscientious teacher will permit a child to come to school day after day and sit with unclean body without availing herself of the opportunity to emphasize the importance of body cleanliness; yet she will suffer a child to come for months with a filthy oral cavity, which exposes the entire class to possible contamination, but rarely, if ever, instructs the child in the procedure for improving conditions. No adult with the self-respect of the average social being would permit himself to remain unclean in body for any period of time, be his position public or private; yet the majority of people in daily life are very negligent of mouth conditions, and permit the oral cavity to become a breeding place for micro-organisms and diseases, which are more dangerous to life than any of the unsanitary conditions about our cities of which we hear so much. To correct these evils it is necessary to wage a campaign of education, the object of which shall be to acquaint the public, the teacher, the mother and the child with mouth conditions, that they may be able to live in the best possible physical condition.—J. B. ROBINSON, *Dental Summary.*

CURRENT DENTAL LITERATURE

Compiled by C. William Rubsam, D.D.S.

Internal Secretions and Dental Caries, with Special Reference to Thyroid Insufficiency. By H. P. Pickerill, M.D., D.D.S., University of Otago, New Zealand.—*Interstate Medical Journal, May, 1914.*

With reference to thyroid insufficiency, Dr. Pickerill points out that prominent investigators have recorded the fact that calcium utilization in the body is intimately associated with the metabolism of the thyroid gland. The thyroid secretion is supposed to act as a lime salt fixative in the body, and that when it is absent, or deficient, the formative organs, or tissues, are unable to utilize, or to hold the salts present in the blood, and thus the bones and teeth do not calcify to the normal extent.

Dr. Pickerill says that he is inclined to think that there is an association between thyroid insufficiency and the presence of dental caries in children. He shows the various systemic effects of thyroidectomy. Rabbits treated in this manner showed a slight excess of calcium in the feces, whereas starch was much better digested than normally. The teeth of thyroidectomized animals lacked the yellow stain and fine black deposit common upon teeth of rodents and other animals, and on human teeth immune to caries. This stain is spoken of as "biochemical," being biologically produced as the result of chromogenic bacteria, or from hemoglobin. The specific gravity of the teeth in the animals operated upon proved slightly less than in the controls. Analysis showed 2.1 per cent. less calcium in the teeth of thyroidectomized animals. The alkalinity of the saliva proved to be slightly less in the latter. The writer found that the saliva of the thyroidectomized rabbit contained slightly less calcium than the controls, and that its submaxillary glands weigh less in proportion to its body.

	Control animal. Per Cent.	Thyroidectomized animal. Per Cent.
Specific gravity of teeth	2.49	2.46
Composition of teeth:		
Mineral matter	80.00	79.16
Organic matter	20.00	20.84
Calcium in ash	40.00	37.21
Calcium in dried teeth	32.00	29.90
Excretion by feces:		
Calcium	.634	1.168
Starch	21.83	18.018
Salivary secretion:		
Alkilinity per c.cm	.85	.65
Alkilinity per minute	.399	.336
Calcium	.0220	.0206
Weight of salivary glands per kilo of body weight	.3473	.2268

It is nevertheless to be observed that the variations in the thyroidectomized animal, although slight, are still all in one direction—namely, in that which would lower the resistance of the teeth to disease. Dr. Pickerill states that it is necessary, however, to be careful of generalization—because thyroid insufficiency may be a causative factor in certain patients—it does not follow, *ipso facto,* that it is always a cause of caries. There are very many other factors—physiological and pathological—also to be taken into consideration.

DIETETICS. By F. C. Husband, D.D.S., Toronto, Canada.—*Oral Health, August, 1914.*

The interest for the dental profession in this article lies in the fact that diet has such a subtle influence upon the health of the dental organs and their environment. The author traces the subject from prehistoric times until the present, showing the tendency of civilization toward a greater inactivity of the strong masticatory powers which formerly were so essential to the individual's well being. He denotes this as the age of pap. The teeth, having been called upon to do less work, have diminished in size, and the bones have even diminished more in bulk, relatively, than the teeth.

The writer asserts that the masticating function is instinctive,

as seen in the infant. It will exercise its toothless gums on any hard substance it can lay hold of. When the teeth have erupted, the masticatory instinct among primitive people finds abundant satisfaction in the chewing of the coarse, hard foods which constitute their dietary, but among us moderns, subsisting as we do, mainly on soft foods, affording but little exercise for the masticatory apparatus, it does not find its proper expression, and thus tends to die out. Children are fed upon soft, mushy foods, thereby learning the pernicious habit of bolting their food. Were they required to use coarser articles of diet, they would acquire the habit of exercising their dental organs properly and save themselves much distress in after life. Mastication cannot be thorough where the bite is defective, and as a consequence, the glands cannot be adequately stimulated, and the food, no matter how good, be properly prepared to enter the stomach. Some are temperamentally more disposed to hurry over their meals than others. The restless, nervous person is more apt to swallow his food hastily than is the more deliberate and phlegmatic. Again, in this hurrying, strenuous age people are much less deliberate than in the easy, slow-going days of long ago. A meal should be regarded as an end in itself, and should be taken at leisure, body and mind for the time being given up to it, and to agreeable social intercourse. If this rule were always observed a most important source of inefficient mastication would be removed. Too much food is eaten as a result of insufficient mastication. Soft foods, which constitute the bulk of our dietary, pass much more readily into the stomach than hard foods, which compel a certain amount of mastication, and for this reason the former predispose to excessive eating, hence a danger at all periods of life, not only in grown-ups but in children, even infants, brought up as the latter are, mainly on liquids and pappy foods. Many of these consume far more than is needful, and far more than is healthful, their stomachs being literally deluged with nutriment. When the food is of a kind necessitating abundant mastication it is much less likely to be taken in excess, for the longer time taken in masticating the less will the individual be tempted to consume. Even with the soft foods, less will probably be taken if they be thoroughly masticated and insalivated than if bolted.

Dr. Husband points out that the young child is largely carnivorous. The mother's milk is such as to meet this desire and need. The jaws, tongue, masticating muscles and salivary glands all get their normal exercise in breast feeding. Sometimes as early as the fourth or fifth month the child indicates a desire to bite. This can be gratified by giving it a chicken bone or chop with the meat practically all removed. This will overcome, to a large degree, the trouble of the teething period. The child should make his first acquaintance with starch, not in the form of a liquid or pappy food or bread and milk, but in a solid and tough form. Till something better is suggested, he would propose hard, well-baked crust as a convenient form. If the crusts be thin, cut into suitable shape and spread with bacon fat or fresh butter, it makes a most agreeable morsel. The same principle should be acted upon during later childhood and youth.

We should always give the starch in a form compelling mastication. Loaves shaped to give the maximum of crust and minimum of crumbs should be baked hard. This gives abundance of dextrine and not a little maltose, and compels efficient mastication if eaten, as they should be, without any fluid.

How are we to know what kinds of food the body requires? The question is a physiological one which is most interesting. To be brief, the healthy appetite should be the guide. The sense of taste, when not debauched, is the conscience of the appetite. Generally speaking, when the economy requires food there is a craving for a specific kind. When it is placed before us our attention should be fixed on it, and the morsel will then be appreciated. It should be broken up and mixed with the saliva and tasted carefully during the process.

None but what has been reduced to a cream and rendered alkaline by the saliva should pass the fauces. This becomes habit in time. When the sense of taste has become satisfied there is a warning, almost uncanny, that enough of this or that element has been taken and the subject turns to something else indicated, and so on, until the appetite is satisfied. In this way there is no glutting or sense of discomfort following a meal, providing the mind is at rest and not irritated. Under certain conditions of convalescence or fatigue the original craving is lacking, but may

be aroused by a mouthful of meat broth. This is, no doubt, the place in our menu for the broth or bouillon, viz.: the first. Then comes the more sustaining, the meat (or proteid) and vegetable (proteid and carbohydrate). It takes five minutes for the flow of gastric juice to start after being stimulated, so by the time the meat course is served the stomach is thus prepared for its work. Then, with the stilling of hunger, we wish to leave an agreeable sensation with the gustatory nerves and yet not burden the digestive organs, and the "sweets," just to the point of satisfaction, are partaken of.

OSTEO-SARCOMA OF THE MANDIBLE. By Dr. C. W. James, Fowler, Cal.—*Pacific Dental Gazette, August, 1914.*

In this article, the writer brings out with considerable emphasis the value of early and accurate diagnosis in a sarcomatous condition of the jaws. He cites one case, and gives its history and termination as follows: A girl, age 19 years, who had had repeated attacks of toothache in a left lower molar, visited a dentist, who extracted it with difficulty. This was followed by rapid swelling, severe chill, hurried pulse and pronounced tumefaction. Repeated exploration by both dentists and physicians, with negative results. Spontaneous evacuation of intra-oral abscess, which then assumed a chronic character, and persisted for a period of two months, with no appreciable change. Stock mixed vaccines, or autogenous vaccines, marked improvement to point of apparent recovery. Development of an epulis; separation of jaws, increasing perceptibly from day to day; increased pulse, with temperature 98-99; failing appetite; hippocratic facies, staring, wide-open eyes, extreme salivation, discharge increasing and changing from a thick yellowish to a watery, offensive fluid containing tissues in an advanced stage of necrosis. Since the diagnosis of malignant sarcoma was not made until after nearly five months of treatment and investigation, three important questions confront us. First, when did the sarcomatization begin? Second, why was not the true condition recognized before it was too late to operate? Third, if recognized soon enough, what would have been the treatment?

The first question, "When did the sarcomatization begin?" cannot be answered with certainty. Whether the sarcomatous

cells were in a latent state in the periosteal tissues, or whether the efforts of the erupting tooth, together with the long-continued irritation, induced the sarcomatus evolution, is merely a matter of conjecture. This was a sarcoma of the small spindle-cell variety, most common of all sarcomata excepting the giant cell, and third in the line of malignancy, the small round cell being first, the large round cell being second. It occurs most frequently under the age of twenty-five years. It is distinguished from the principal connective tissue tumors, in that it rarely possesses a capsule, and, having no restraining capsule, it infiltrates the adjacent tissues.

This variety ranges in size from that of a walnut to that of a man's head. It may arise in any situation where connective tissue exists, following a slight trauma. It first appears as a very small tumefacted or pedunculated mass, and is accompanied by pain. It grows gradually, and, having the tendency to infiltrate the surrounding tissues, induces metastasis through the blood stream. After it becomes large, the central part becomes necrotic and sloughs off, or is discharged through a sinus, on account of decreased blood supply.

Replying to the second question, the writer states there is no doubt in his mind that simultaneously with the extraction of the tooth, and the starting of the new growth, an acute infection set in. It occurred as the result of trauma, followed by invasion of micro-organisms either from the offending tooth or from some external source. It is almost impossible for a small spindle-cell sarcoma to show such aggravated symptoms of infection as were exhibited in the case. Now it is easy to see why the true condition had existed for so long a time in an unrecognizable state. Had this sarcoma appeared in the usual manner, unmasked by an acute infection, the correct diagnosis could more easily have been made. Early microscopic examination would probably have shown the true condition, but unless this had been done before extensive metastasis had taken place, operation would have been impossible.

As to the third question: The one hopeful remedy at the present time lies in the complete and thorough excision of the growth, and "block" operations upon the lymphatic glands which drain the affected parts, and in the removal of the submaxillary,

internal maxillary and upper deep cervical glands. This operation would consequently have necessitated the resection of the mandible from the mental foramen in front to about one and one-half inches below the condyle. To these ends an artificial jaw could have been fastened. Operation for sarcoma of the alveolar process involving the bone of the lower jaw shows a high mortality. Warren reports 40 operations performed at the Massachusett's General Hospital. Ten deaths are reported as the result of the operation, and out of the entire number, within a five-year limit, and there were but three cures.

GAS-OXYGEN ANESTHESIA. INDICATIONS FOR ITS USE. By A. H. Miller, M.D., Providence.—*Dental Register, July, 1914.*

There are a number of surgeons who hold that nitrous oxid and oxygen is the ideal anesthetic, and that it should be used for all surgical work. There is a larger group who maintain that this anesthetic has no place in the surgical field. In favor of the latter view are the facts that a number of deaths have resulted from the use of nitrous oxid and oxygen, and that this anesthetic does not produce sufficient relaxation in the average case for the work of many surgeons. On the other hand, it may be said that many lives have been saved through its use which would have been forfeited under any other anesthetic. The deaths under nitrous oxid and oxygen anesthesia which have been reported are set down in the following table:

Observer.	*Death ascribed to.*	
Teter	Shock and primary cardiac failure	1
Crile	Myocarditis, six hours after operation	2
Lydston	Anesthetic	3
Allen	Uremia	4
Allen	No details	25
Allen	No details	25
Gatch	Hyperthyroidism	5
Gatch	Pericardial effusion	5
Gatch	Lymphatic diathesis	5
Olow	Diseased heart and arteries	6
Boys	Anesthetic	7
Miller	Suffocation (vomitus inspired)	8
Flagg	Anesthetic	9
Teter	Impure gas	10
Teter	Impure gas	10
Salzer	Anesthetic	11
Collins	Impure gas	12
Buchanan	Anesthetic	13

In a number of the foregoing cases, death occurred as a result of lack of care in the selection of the anesthetic. The nitrous oxid and oxygen was employed in spite of manifest contra-indications to its use. It is worth while to consider carefully the indications and contra-indications in the use of nitrous oxid and oxygen. The indications for the use of nitrous oxid and oxygen anesthesia are as follows:

(1) Depending on the condition of the patient: Anemia; diabetes; acute infections; impaired kidneys, as nephritis; pyelitis; respiratory affections, especially in the aged, as tuberculosis, pneumonia, bronchitis, laryngitis; bad surgical risks, as in typhoid perforation; grave general peritonitis; intestinal obstruction; shock, collapse; debility; the very ill; old age; lowered vitality from any cause.

(2) Depending on the nature of the operation: Many minor operations, manipulations, examinations, and dressings; operations on extremities; obstetric operations; breast operations; operations for empyema; when the effect of surgical shock is feared.

(3) To avoid post-anesthetic nausea and vomiting.

The contra-indications to the use of nitrous oxid and oxygen anesthesia are as follows:

(1) Absence of expert anesthetist and perfected apparatus.

(2) Depending on the condition of the patient: Bad heart lesions with broken compensation, myocarditis, fatty heart, dilated heart; aneurism; respiratory obstruction; enlarged tonsils and other marked narrowing of upper air passages; tumors of neck, including thyroid growths; cellulitis of submaxillary and cervical region; emphysema; arterio-sclerosis; increased intracranial pressure from tumor or abscess; intestinal obstruction with distended abdomen; children under five years of age; strong, vigorous, rough men; extreme nervous temperaments; addiction to drugs, or use of tobacco or alcohol.

(3) Depending on the nature of the operation: When perfect relaxation is desired for operations on healthy subjects; operations on larynx and trachea.

From the foregoing, the writer concludes that it is evident

that nitrous oxid and oxygen is not the ideal anesthetic for use in all cases. It is also certain that it is an agent of the greatest value in certain selected cases. To determine the proper indications for its use, it is necessary to consider the condition of the patient and the nature of the operation. In no case should it be used in the absence of a skilled administrator.

CURRENT NEWS

[Items of professional news, of general interest, will be welcomed by the Associate Editor at 51 West Forty-seventh New York City.]

The Standardization Committee of the Board of Estimate and Apportionment of New York City has proposed the following rating of all employees who are considered members of the "Dental Group" of the city, hoping it will thus be recommended to the Board of Aldermen. If the proposal is passed upon favorably by the last named board, all the dentists in the employ of New York City will benefit annually by an increase in salary, if their work warrants this advance.

The suggested rating is as follows: That there be three grades in the "Dental Group," Numbers I, II and III. Those in Grade I, the lowest group, shall be known as "Dental Internes," and their duties shall be "to execute, under direction and supervision, such dental work as is commonly required of a dental interne in the care and treatment of hospital patients. They shall have the minimum professional and educational qualifications prescribed for the "Dental Group," but not necessarily any practical experience other than that which is incident to the attainment of such qualifications.

The range of annual compensation (at present a dental interne receives no salary whatever) shall be from $240 to $360.

Those included in Grade II shall be known as "Junior Dentists." They shall have a State Board license and their duties shall include the filling and cleansing of teeth, the performing of minor oral operations and routine work in the dental laboratories.

The salary rates recommended are $900, $1020, $1140, $1260, $1380; for services, averaging at least eighteen hours a week. Of course, maintenance shall also be given to dentists on full time in hospitals or other institutions. A necessary qualification for advancement from one salary rate to the next higher rate shall be a minimum of one year of service at the lower rate.

Grade III of the "Dental Group" includes men distinguished as "Dentists," who shall be capable of exercising the highest degree of skill and judgment, and of supervising the work of those in the other groups, in the clinics or hospitals.

Members of this group shall have the minimum professional, educational experience and qualifications prescribed for Grade II, plus not less than two years' experience in work of Grade II standard. The compensation shall be from $1560 up, and all must render services averaging at least eighteen hours a week.

THE JOURNAL wishes to point out that this recommendation shows a distinct advance in the appreciation of the importance of dental service. The proposed salaries are fair, but no greater than ought to be paid by New York City in return for skill, brains and executive ability along the line of this great specialty of medicine.

* * *

Several years ago, the late Dr. Benjamin Lord, of New York City, succeeded in interesting some of his wealthy patients in the possibilities resulting from dental research work. Consequently, the "Lord Fund" was established largely from this source, and the New York Institute of Stomatology was given the care of it with the stipulation that it be used in the interests of dental research.

A few years later, Dr. J. Morgan Howe, chairman of the Research Committee of the Institute, realizing the advantages to be derived from placing the investigations in the hands of a man skilled in his profession, managed to secure the cooperation of Dr. Wm. J. Gies, Professor of Biological Chemistry in Columbia University. Neither at this time nor at any other has Dr. Gies accepted any remuneration for his personal services, the only outlay being for actual expenses. His work, upon the etiology of dental caries is now well known and has been continued year by year without a break.

When, in 1910, the three other New York City dental societies decided that they could accomplish more by uniting with the First District Dental Society of the State of New York to form one large body, the "Lord Fund," amounting then to approximately $3000, was turned into the treasury of the resultant big society by the Institute of Stomatology, to be used as a research fund, and the excellent work done annually by Dr. Gies and his associates went on as before.

For the past few years, the New York State Dental Society,

recognizing the exceptional capability and personal interest in dental research felt by Dr. Gies, has appropriated $500 annually toward the cost of his investigations of the causation of dental caries, and, during the past year, the influence of the internal secretions on the human body and indirectly upon the teeth.

The results of this work have now made such an impression, that the National Research Commission (Dr. Weston A. Price, chairman) of the National Dental Association, this year at the meeting in Rochester, voted $500 to add to the like sum voted by the New York State Society.

Accordingly, just twice as much work can be done this year by Dr. Gies and his assistants in this important direction, and THE JOURNAL is glad to note the increasing desire for knowledge upon the part of the dental profession and the widened appreciation of Dr. Gies' fitness to be its instrument in the pursuit of this knowledge.

* * *

The question of "Professional Journalism" was very much in the foreground at the National Convention in Rochester. This all-important question has been agitated at the convention for many years, but for the first time something definite was really done.

Broad-minded men are rallying in great numbers annually to the standard and principles that our own JOURNAL has been supporting almost single-handed for the past nine years, and there are now fewer opponents of "Professional Journalism" than ever before.

The House of Delegates in Rochester voted to establish a "Journal of the National Dental Association" not later than January, 1916. Fifteen hundred dollars has already been set aside as a journal fund and it was decided that a like sum should be added annually for the next two years.

A commission of five men was appointed to establish and take charge of this new journal. They are as follows: Dr. Burton Lee Thorpe, St. Louis; Dr. Otto U. King, Huntington, Ind.; Dr. W. H. G. Logan, Chicago; Dr. W. E. Grant, Louisville, Ky., and Dr. Herbert L. Wheeler, New York City, chairman.

Thus, for the first time, the proceedings of the National

Dental Association will be published in a journal that is paid for by dentists, a thoroughly independent journal.

This is a great step forward and we should all be proud that our profession has at last seen the light.

* * *

Dr. Matthew Carney, 51 East Forty-second Street, New York City, has been appointed to the position of "Advertising Editor" of The Journal. Dr. Carney is one of the coming men of our profession and is well known as the Supervisor of Dental Clinics, Bureau of Child Hygiene, New York City. It may also be said that he is now one of the foremost workers in the campaigns for the betterment of the health of school children, and in the "Oral Hygiene" movement.

The Journal is glad to welcome Dr. Carney to its staff and feels that it is fortunate in having secured his interest and cooperation.

BOOK REVIEWS

By C. Franklin MacDonald, D.M.D.

Prevention of Dental Caries and Oral Sepsis. By H. P. Pickerill, M.D., Ch.B., L.D.S. Second edition, 1914. Publishers: S. S. White Company, Philadelphia. Price, $4.00.

The profound stir which the first edition of Dr. Pickerill's book made among dental scientists and the profession at large has brought forth this second edition to supply the increasing demand of dental readers.

This work of over three hundred pages and, as the author states, the summary of more than six years' active research, contains data, interesting and startling, contrary in some phases to the usual teachings, but nevertheless most impressive and worthy of serious thought.

Beginning with an investigation into the incidence of dental caries the conclusion is reached that civilization is responsible for the increase of dental caries, and the author endeavors to ascertain what factors of civilization are responsible for this increase. The writer is fortunate in his field of work being in New Zealand, where he is able to carry on investigations among the Maori race, which has only been under the influence of civilization for the past seventy years. As a preliminary, he considers the pathology of dental caries and various influencing factors, such as age, habit, adenoids, heredity, etc. The essential factor in the production of caries he thinks is the lodgment and infection of carbohydrate material, while the bacterial plaques he considers not primarily essential, but coincident. Regarding adenoids, he feels that they develop from the habit of mouth breathing rather than that they are the cause of mouth breathing.

The enamel of the tooth is carefully investigated, being most important as the natural protection of the tooth. In this investigation he brings out many interesting facts, such as the imbrication lines upon the enamel surface with his idea of the origin of such lines; the physical properties of enamel, viz., differences of density and hardness of surface; the relative solubility and permeability of enamel. The theory of the possible function

of Nasmyth's membrane as a dialyzing membrane and the penetration and absorption by enamel of the crystalloid salts of the saliva is, at least, highly interesting.

The oral secretions are considered as the active forces of natural protection, and here a wealth of original research is presented, relative, especially, to the stimulation or depression of salivary flow by various foodstuffs. Two conclusions in this respect: "That acids, and particularly the natural organic acids, are the stimulants, and excite the greatest amount of these protective substances per minute, and, moreover, give rise immediately, and for a considerable time afterward, to an increased alkalinity of the mouth. . . . That in the saliva is provided a natural and potentially perfect mouth wash acting continuously day and night. That it is, moreover, completely under control; that it may be altered or varied in amount or composition; that its beneficial effects may be increased or decreased absolutely at will." These statements give an idea of what the aim of the author has been in this work.

Under the title of oxygenetic factors and the means of their reduction, Dr. Pickerell enters into an investigation of the various common foodstuffs as to their convertibility into acid products and the possibilities of preventing this acid formation. The inoculation of the mouth by other organisms to overcome this acid production is quite startling, and while the author claims his investigations are not complete, he considers that "there is every probability of the method being an extremely valuable asset in the preventive treatment of dental caries." In pursuance of the author's belief in the employment of acid mouth washes, he presents some sample formulæ, the basis of which consists of acid potassium tartrate and tartaric acid. There is also an interesting chapter upon alimentary secretions as a whole, in which the writer proceeds to show that acids stimulate their flow, while alkalies tend to depress them, in this manner being identical with the saliva.

The volume closes with chapters upon the dietetic régime of those races most free from caries and the average diet of civilized school children. In these is clearly brought out, the relatively large use of foods, which are salivary stimulants among

the immune races. Suggestions are made pertaining to a more reasonable diet or combination of foods for use by civilized people which would tend to overcome the ravages of dental decay. Education, beginning with the proper instruction of teachers, and even medical men, is urged, and legislation is proposed as a help in the direction of combating dental caries.

This may be said to be one of the most important dental works of recent years, and destined to exert a tremendous influence upon dental thought and teaching. Contrary to what might be expected in a scientific investigation of this kind, the subject matter will prove to be readily understood and most interesting, so that every one of the dental profession who wishes to keep abreast of the times should carefully and seriously read this book.

Principles and Practice of Operative Dentistry. By John Sayre Marshall, M.D., Sc.D. Fourth edition, 1914. Publishers: J. B. Lippincott Company, Philadelphia and London. Price, $6.00.

Dr. Marshall has now issued the fourth, revised edition, of his operative dentistry, which during the past years has become familiar to the dental profession.

The book retains the essential outlines and plans of the previous editions, but it can be said that, on the whole, the subject matter has been brought strictly up to date, especially relative to theoretical teachings. It is in respect to the presentation of the theoretical considerations of the subjects included in operative dentistry that this volume is particularly to be noted. It contains much more data along these lines than is to be found in the usual book of operative dentistry. The author has undoubtedly read most extensively the latest reports of findings along all lines and has drawn freely upon these sources, condensing, uniting and designating what the present opinions and judgments seem to be among the scientists.

Beginning with the usual descriptive anatomy of the teeth, Dr. Marshall presents the histological and developmental phases and the latest findings upon these subjects.

The chapter dealing with the bacteriology of the mouth is

more extensive than usual, and puts forward the very latest knowledge pertaining to mouth bacteria.

In the sections devoted to dental caries and its treatment, while presenting the older, orthodox theories, he has also quoted extensively from the very recent work of Dr. Pickerill and likewise from the investigations of Drs. Wallace and Gies, relative to the use of fruit acids and proper dietetic régime in combatting caries; their researches being, as he writes: "To say the least, very compelling in their suggestiveness." Under the wedging of teeth the author rather seems to favor the use of rubber wedges, but does not mention the method of tying various kinds of ligatures between the teeth, which is now quite common practice and generally most successful.

Dr. Marshall believes in the necessity for painless dentistry, and has devoted some pages to this matter. Cataphoresis is first considered, and the theories of this method are outlined with some general remarks upon electrolysis, batteries, rheostats, etc. Local and peripheral anesthesia is carefully presented, but could have been made more complete by including further information concerning conductive anesthesia of the superior and inferior dental nerves. As to general anesthesia, while advocating its necessity under many conditions, the writer sounds a warning against a too promiscuous and careless use of same, especially by those not fully trained in the administration of anesthetics, and says: "Although nitrous oxid is the safest of all anesthetics, no anesthesia, either local or general, is ***absolutely safe***."

The author has included a short chapter upon electro-therapeutics, which subject is beginning to be brought more and more to the attention of modern dentists.

The chapters devoted to the filling operations discuss the usual lines of treatment as laid down by conservative teaching. The section relating to inlays seems rather meager in details, and does not consider the making of inlays by the indirect methods.

The causes, pathology and symptomatology, of the diseases of the pulp and peridental membrane, are taken up in successive chapters with the appropriate treatments for the conditions. In the treatment of obstinate cases of alveolar abscess,

Dr. Marshall is "of the opinion that the more heroic operation of extraction and replantation gives a larger percentage of cures" than the method of amputating the diseased root apex. This opinion seems open to considerable dissension and controversy.

Under Pyorrhea Alveolaris, the writer presents in concise form the various theories advocated by the principal investigators of this most baffling of all dental subjects. For his purpose he divides the disease into three general forms, one purely local and the others constitutional or systemic—namely, first, ptyalogenic pericementitis; second, hæmatogenic pericementitis; third, phagedenic pericementitis. The usual treatments for these conditions by instrumentation, prophylaxis, and constitutional means are more or less detailed. The use of vaccine therapy is considered, but its ultimate value is rather doubted.

The book closes with a chapter upon extraction.

For the reader who wishes a book upon operative dentistry which embodies all of the modern conceptions of dental theories and facts, this volume should fulfill that need. For the student, when taken in conjunction with regular practical teaching, it should prove quite excellent. It rather seems to lack somewhat in the practical or mechanical details of operative procedures. The book is finely and clearly illustrated throughout, many of the plates being of the highest order.

OBITUARY

George Edwin Hunt, M.D., D.D.S.

George Edwin Hunt, M.D., D.D.S., a prominent dentist and educator, died very suddenly at his home in Indianapolis, Ind., on the morning of July 11, 1914, of acute gastritis.

Dr. Hunt had just returned to his home after attending the meeting of the National Dental Association in Rochester, where he appeared in his usual health, and the announcement of his sudden death came as a shock to his many friends and colleagues.

George Edwin Hunt was a son of Dr. P. G. C. Hunt, one of the prominent pioneer dentists of Indiana; he was born in Indianapolis on April 29, 1864, and received his early education in the public schools in the city of his birth; in 1882 he entered Asbury University, now De Pauw University, where he spent two years in the study of civil engineering; following this, he spent one year in the University of Michigan, at Ann Arbor; in 1888 he matriculated in the Indiana Dental College, from which institution he was graduated in 1890; the next autumn he became a student of medicine in the Indiana Medical College, and after two years of study received the degree of M.D.

After graduation he became associated with his father in the practice of dentistry, in which relation he continued until the time of his father's death in 1896; thereafter he discontinued active practice and devoted his entire time to educational and literary work. In 1891 he became secretary of the faculty of the Indiana Dental College, and in 1900 was chosen dean of that institution, which office he occupied until his death.

Dr. George Edwin Hunt was a man of force and energy, actively interested alike in the welfare of his profession and his municipality. He was a member of the National Dental Association, the Indiana State Dental Association, the Institute of Dental Pedagogics, the National Association of Dental Faculties, the Indianapolis Dental Society, and Delta Sigma Delta Fraternity, in all of which organizations he filled offices of honor and responsibility. He was a member of many civic societies

in his home city and State, and gave freely of his energy to all of these associations.

His principal interest may be said to have centered in the welfare of the student body; he was ever ready to counsel and aid the younger man in his effort to succeed.

On June 23, 1909, Dr. Hunt was married to Maria Foster Buchanan, who survives him, and to whom we extend profound sympathy in her bereavement.

The funeral services were conducted under the auspices of the Masonic Order, and, in accordance with the expressed wishes of Dr. Hunt, the body was cremated. F. C. K.

Leslie Edwin Palmer, D.M.D.

Died August 13, 1914, in New York City, of appendicitis and adhesions of the intestines, Leslie Edwin Palmer, D.M.D., in his thirty-fourth year.

Dr. Palmer was born in Palmer, Mass., November 23, 1880; the son of J. E. Palmer and Clara I. Allen. His early education was received in the schools of Massachusetts, and he graduated in 1907 from Tufts Dental College.

Immediately upon graduation he associated himself with Dr. E. Wunsche, of Berlin. He remained there two and one-half years, and returned to New York to become the associate of Dr. Henry W. Gillett. In that association he had built up, very rapidly, a remunerative practice, and had developed a marked ability in practical Roentgenology.

Deceased is survived by his widow, née Jeannette E. Rommel, of Kingston, N. Y.

Henry W. Gillett.

NOTICES

THE PANAMA-PACIFIC DENTAL CONGRESS

The Committee of Organization of the Panama-Pacific Dental Congress is pleased to present to the members of the dental profession the following report showing the progress of the work of organization, feeling certain that a sound foundation has been laid for the greatest dental meeting ever attempted.

Letters received by the committee from every state and country in the world indicate a widespread and lively interest in the congress and give promise of a record breaking attendance. At the present time, sixteen months before the opening of the congress, over one-third of the space for exhibits has been reserved, many applications are pending, and without doubt the whole twenty-two hundred front feet of exhibit space will soon be taken. Contributions to the program are now beng received and the success of the meeting is assured. The Panama-Pacific International Exposition, as far as its buildings and grounds are concerned, is rapidly assuming a finished appearance. All the great exhibit palaces, eleven in number, will be ready for occupancy on or before the first day of next July, two of them being ready for exhibits at the present time.

An idea of the size of these buildings may be obtained by noting the fact that the machinery building, now finished, is one and one-third miles around the cornice and contains over nine million feet of lumber.

The Exposition will be "Ready on Time," and everyone should plan to see, what, for many years to come, will be the last word in great educational and industrial expositions.

The Dental Congress will be held during the pleasantest season of the year, when the Exposition will be at the height of its activity and no member of the dental profession, who can by any possibility come to San Francisco at that time, can afford to miss the Exposition and the Congress.

OFFICERS AND MEMBERS OF THE COMMITTEE OF ORGANIZATION.

Dr. Frank L. Platt, Chairman, 323 Geary Street, San Francisco.
Dr. Arthur W. Chance, Vice-Chairman, Corbett Building, Portland, Ore.
Dr. Arthur M. Flood, Secretary, 240 Stockton Street, San Francisco.
Dr. F. G. Baird, Butler Building, San Francisco.
Dr. H. A. Fredrick, 2152 Sutter Street, San Francisco.
Dr. Joseph Loran Pease, Central Bank Building, Oakland, Cal.
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Dr. Charles M. Benbrook, Auditorium Building, Los Angeles, Cal.

Dr. George T. Williams, Cobb Building, Seattle, Wash.
Dr. Geo. F. Stiehl, Salt Lake City, Utah. .
Dr. B. M. Brookfield, Idaho Falls, Idaho.
Dr. H. H. Wilson, Phoenix, Ariz.

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Dr. R. H. Hofheinz, Vice-Chairman, 818 Chamber of Commerce Building, Rochester, N. Y.
Dr. W. H. Renwick, Secretary, Sacramento, Cal.

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Dr. H. E. Friesell, Vice-Chairman, Highland Building, Pittsburgh, Pa.
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Dr. F. W. Hergert, Vice-Chairman, Cobb Building, Seattle, Wash.
Dr. C. O. Edwards, Secretary, 3989 Howe Street, Oakland, Cal.

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Dr. C. N. Johnson, Chairman, 22 East Washington Street, Chicago, Ill.
Dr. Homer C. Brown, Vice-Chairman, 185 East State Street, Columbus, Ohio.
Dr. Henry C. Fixott, Secretary, Portland, Ore.

RULES GOVERNING OFFICERS OF SECTIONS, AND STATE AND NATIONAL EXECUTIVE COMMITTEES.

Rules governing the Officers of Sections and Chairmen and Members of State and National Executive Committees of the Panama-Pacific Dental Congress, to be held in San Francisco, Cal., August 30 to September 9, 1915.

Rule I.—The Officers of each Section shall constitute the Board of Censors for that Section.

Rule II.—The Officers of each Section shall co-operate with State and National Executive Committees in securing papers and clinics for the program of the Congress, and also with the Program and Clinic Committees.

Rule III.—The Officers of each Section and the chairmen and members of State and National Executive Committees are empowered to solicit and receive from legal and reputable practitioners of dentistry and medicine, and persons proficient in the allied sciences, papers and clinics on subjects of interest to the Congress, it being understood that each essayist or clinician is an authority on, or particularly well qualified to deal with, the subject presented.

Rule IV.—The Chairman of each Section is invited to deliver an address before his Section, not to exceed twenty minutes in length; this address to constitute one of the papers of that Section.

Rule V.—The aggregate number of papers accepted shall not exceed ten for each Section, and not more than two-fifths of those accepted may be read by title.

Rule VI.—Papers may be read and discussed before the Congress in any language, but copies of all papers, or summaries of papers, and discussions, typewritten in the English language, ready for printing, must reach the Program Committee in San Francisco not later than May 1, 1915.

Rule VII.—Each paper and discussion will be printed in full in the

published transactions of the Congress, but a maximum of twenty minutes only will be allowed for the reading of a paper, or a summary of it, embracing its leading points, in case the reading of the original would occupy more than the allotted time, and five minutes for each speaker taking part in the discussion; not more than fifteen minutes will be allowed for the discussion of any paper, and the author will be allowed five minutes in closing the discussion.

The author of each paper is requested to furnish the Secretary of the Section to which his paper belongs with the names and addresses of those who will discuss his paper.

Rule VIII.—No clinic will be given a place on the program of the Congress unless a concise description of it, typewritten in the English language, ready for printing, reaches the Clinic Committee in San Francisco on or before May 1, 1915.

Rule IX.—State and National Executive Committees are governed by the rules governing the Officers of Sections, so far as they apply. Note particularly Rules II, III, V, VI, VII and VIII; also

Rule X.—Each contribution to the program, either paper or clinic, shall be sent promptly to the Chairman of the Section in which its title indicates it to belong. In case of doubt, it shall be sent to the office of the Committee on Organization in San Francisco, this committee determining its place on the program.

Rule XI.—In the event of any controversy arising between contributors and the officers of any Section the question at issue shall, at the discretion of the officers of the Section, be submitted to the Committee of Organization for final adjustment.

QUALIFICATIONS FOR MEMBERSHIP.

State and National Executive Committees are empowered to receive applications for membership from none but legal and reputable practitioners of dentistry, who are personally known to be such, vouched for by an officer of the principal dental society of their locality, or by some other known reputable and legal practitioner. Each application must be signed by a member of a State or National Executive Committee.

Membership fee is Ten Dollars.

Visitors to the Congress not eligible for membership.

Members may introduce members of their families as visitors to the Congress upon payment of a fee of $2.50.

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Dr. Herbert J. Samuels, Central Bank Building, Oakland, Cal.
Dr. Shirley J. Ashby, 3846 Twenty-fourth Street, San Francisco.
Dr. M. J. Congdon, Eastman Building, Berkeley, Cal.
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Dr. Samuel W. Hussey, 2649 Russell Street, Berkeley, Cal.
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Dr. Homer T. Craig, 509 Butler Building, San Francisco.
Dr. H. C. Peters, 323 Geary Street, San Francisco.

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The appointment of other State and National Executive Committees is now pending.

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At the annual meeting of the International Dental Federation, London, England, August 6, 1914, the following officers were elected for 1914-15:

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Next place of meeting San Francisco, August 30, 1915.

BURTON LEE THORPE,
Assistant Secretary.

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Office of the Secretary,
14 Water Street, Haverhill, Mass.

A meeting of the Massachusetts Board of Registration in Dentistry, for the examination of candidates, will be held in Boston, Mass., October 21, 22 and 23, 1914.

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VOL. IX DECEMBER, 1914 NO. 4

DEDICATION OF THE FORSYTH DENTAL INFIRMARY FOR CHILDREN

AT BOSTON, MASSACHUSETTS, NOVEMBER 24, 1914.

The dedication of the Forsyth Dental Infirmary for Children on Tuesday, November 24, 1914, marked the dawn of a new era in dentistry.

This magnificent structure, so beautifully situated, with the great monuments of art, music and science surrounding it, has opened its doors to receive the suffering children of Boston and vicinity and has started upon its great work of aiding the little ones.

There have been erected many monuments to commemorate great men, mausoleums to shelter the ashes of heroes; but here is a living memorial, a vital, active unit dedicated to the noble cause of charity.

To comprehend the artistic beauty combined with the absolute practicalness of this memorial, one must visit it. Words fail to impress the reader with the magnitude and art of this new "Acropolis." The architect is deserving of great praise for having executed such a splendid structure. Modern sanitation, utility and Grecian art are admirably combined in this building. From the mural decorations, depicting stories of childhood, such as "The Midnight Ride of Paul Revere," "The Pied Piper," "Old King Cole," "Puss in Boots," etc., to the general layout

of the recovery rooms and the size of the operating chairs, the child has had first consideration. This building will do much to eradicate the fear of the dentist from the impressionable mind of the child. It would be hard to overestimate the amount of good that will come to young America and the dental profession from this new fountain of health.

The exercises were largely attended by people from all parts of the country and all walks in life. The Church, the State, dentistry and medicine were eminently represented on the platform in the vast operating room of the building. Although the speakers were numerous, all spoke briefly, and thus there was variety and brevity—a combination much to be desired at any event of this kind.

Thomas Alexander Forsyth, the only living one of the three brothers who so generously donated the funds that this dream might be realized, was present to speak for himself and his departed brothers.

Dr. Edwin T. Darby, of the University of Pennsylvania Dental School, presided.

The exercises were opened by Mgr. Splaine. Governor David I. Walsh of Massachusetts commented on the fact that the Forsyth Infirmary is performing a function of the Government—that is, it is looking after the welfare of the children and the health of the future. He said:

"Thank God for such men as these who have made possible an institution where little children can be relieved of their pain, suffering and agony. This will be a monument to those men who have gone, greater than any of those which stand in public squares or parks. It is a monument the meaning of which every child of the future will carry in his mind. Speaking for Massachusetts and the heart of its people, I ask here to-day that the memory of these great men be blessed by all of us, and I wish this undertaking godspeed and unbounded success."

Mayor James M. Curley of Boston paid a glowing tribute to the Forsyth brothers, as follows:

"This institution, in my opinion, will prove not only a blessing to the children whose sufferings it will alleviate and whose bodies it will strengthen, but should tend so to change the current of public thought as to cause its donors, the Forsyth brothers, to outrank in the estimation of thinking men and women the greatest warriors of our time."

Dr. Charles W. Eliot, President Emeritus of Harvard University, spoke of applied science in its relation to dentistry in the following terms:

"The advance of applied science, and particularly of chemistry, physics and bacteriology, within the past seventy years, has nowhere taken effect more advantageously than in dental medicine and the dental art. American inventiveness took effect chiefly on the tools and mechanical processes of dentistry. German chemical science made valuable additions to the materials with which teeth are filled, and the electric current made possible the use of machine drills. Bacteriology has shed a flood of light on the processes of inflammation and suppuration, and on the methods of contagion or infection; and both chemistry and physics have supplied various means of preventing and diminishing pains in dental operations.

"These improvements in the science and art of dentistry have enabled the profession to do for individuals much more than they were formerly able to do for the preservation of health and prolongation of life; but simultaneously with this larger possibility of service has gone the greater cost of the service; so that the skillful treatment of the teeth from childhood to age has become more and more the privilege of the well-to-do, the poor being unable to pay for the costly labors of the accomplished dentist. A clear perception of the deprivations which the less fortunate or successful portion of the community suffers in this respect has led to the establishment and endowment of this infirmary for children. In this beautiful and perfectly-equipped building, the children of persons whose earnings are not much more than sufficient to cover the ordinary expenses of their families, are to obtain, at merely nominal cost, as skillful dental service as the well-to-do can buy for their children; and through the service of trained dental nurses the persons responsible at home for the children here treated will be taught how to keep the children's mouths in as good order as their general health permits.

"In my view, the teaching function of this institution will be the most telling part of its total work. It is well to put a child's teeth in good order for once and at the moment the child leaves the dental chair; but it is better to teach the mother or sister at home how to keep that child's mouth in good order.

"This building is a monument as well as an infirmary and school. It perfectly illustrates one of the admirable traits of successful business men in the United States—the desire on their part to make use of their

private earnings and accumulations to advance some beneficial public undertaking. It also illustrates fraternal love and concord. Long may it stand to speak to coming generations of these fine human qualities and to relieve pain, promote health and prolong life."

The love and charity behind the gift is best shown in this paragraph taken from the remarks of Thomas Alexander Forsyth:

"It has been my wish that the infirmary should be as a home to the children, beautiful and cheerful; a protector of their health, a refuge in their pain. By making them healthier and happier I hope it may make them grow to be better citizens of our beloved Boston. If this is accomplished, as I believe it must be with the co-operation of the dental profession, I shall feel that the gift has been well bestowed."

Mr. Edward McSweeney, trustee of the Boston Consumptive Hospital and chairman of the Port Directors, Boston, made some very interesting remarks and quoted some valuable statistics on the prevalence of dental caries among the criminal class. In his résumé of the various problems that have to be contended with in school inspection work, he said:

"Dentistry has been the question that has been perplexing us, but, the Forsyth Dental Infirmary is the answer. Unless the present death rate from tuberculosis is reduced, of the 128,000 children now in the public schools 12,000 will die of tuberculosis, a large number of them before reaching the age of 25, without giving anything in return to the State for the money spent on their education, with this number of human units transferred on the ledger of human efficiency from the asset to the liability column. For those who will die without becoming productive, the city of Boston will expend $3,000,000 on elementary education alone, so that if we consider the object of education as being the training for efficient citizenship in its broadest sense, these $3,000,000 will have been wasted."

The other speakers were: Edward T. P. Graham, architect of the building; John F. Dowsley, D.D.S., president of the State Board of Registration in Dentistry and a trustee of the institution; Milton J. Rosenow, M.D., Professor of Hygiene, Harvard University; Donald M. Gallie, D.D.S., president National Dental Association; Edward McSweeney, chairman of Port Directors,

Boston; William J. Gallivan, A.B., M.D., Commissioner of Health, Boston, and chief of the Bureau of Child Hygiene.

Benediction was pronounced by Bishop Lawrence.

During the afternoon the building was thrown open to the inspection of the public. Fully 2,000 people availed themselves of the opportunity of inspecting the institution.

In the evening a dinner was given at the Algonquin Club, where the guests included Dr. Edwin T. Darby, of the University of Pennsylvania, master of ceremonies at the dedicatory exercises; Mgr. Splaine, Thomas A. Forsyth, Mayor Curley, Dr. Donald M. Gallie, Chicago; Dr. Eugene H. Smith, Mr. Edward McSweeney, Dr. Charles Painter, Boston; Dr. Charles H. Oakman, Detroit; Dr. Charles A. Brackett, Newport; Dr. William J. Gallivan, Dr. Alfred C. Fones, Bridgeport, Conn.; Dr. James A. McManus, Hartford; Dr. Myer L. Rhein, New York; Dr. R. Ottolengui, Dr. Eudore Dubeau, dean of Dental School, McGill University, Montreal; Dr. Henry A. Kelley, Portland; Dr. Walter H. Richardson, Worcester; Dr. Frank A. Delebarre, Boston, and the author. Dr. Harold De Witt Cross, was toastmaster.

MATTHEW CARNEY, D.M.D.,
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A STUDY OF THE PHYSICAL DEVELOPMENT OF THE OCCLUSAL CURVE[1]

By Frank A. Delabarre, A.B., D.D.S., M.D., Boston, Mass.

I. DEFINITION.

The occlusal curve may be defined as being the curved arrangement of the teeth as viewed from the side.

It is sometimes called the "Curve of Compensation," or "Curve of Spee."

If an imaginary line may be drawn from the incisors backward, touching the points of the cusps of each tooth it will curve slightly downward from the incisors, touch its lowest point in the bicuspid region and curve upward toward the last molar; if continued at the same rate of curvature, will cross the external auditory meatus (Fig. 1).

The evident purpose of this curve is to permit the teeth to perform the separate functions of incising and masticating, without either interfering with the other.

II. LIMITATIONS OF THE SUBJECT.

As indicated by the title of this paper, the presentation will be limited to the purely physical phase of the subject, beginning at the age of three, when the primary dentition is complete; and studying the developmental change that occurs in the occlusal curve.

III. FACTORS THAT DETERMINE THE DEGREE OF CURVATURE.

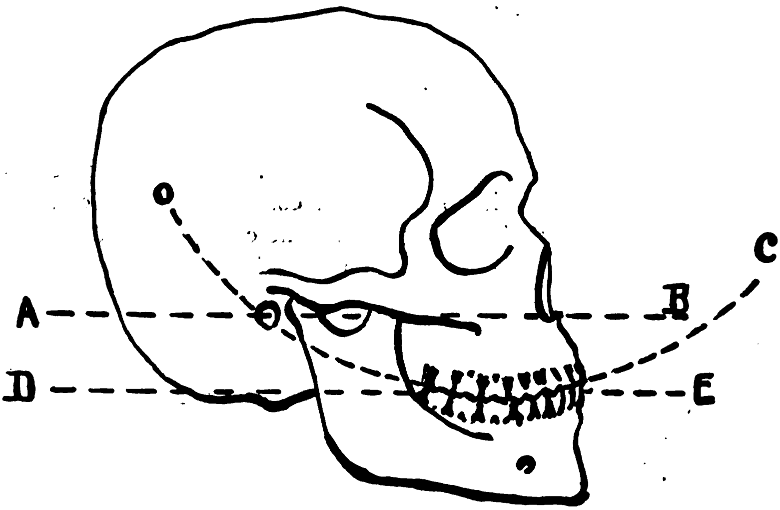
Among the physical factors that determine the degree of curvature may be mentioned the following:

a. The distance between the condyles.
b. The distance from the incisors to the condyles.
c. The depth of the fossa.
d. The height and angle of the eminentia articularis.
e. The condyle path.
f. The difference between the horizontal levels of the occlusal and condyle planes.
g. The height of the cusps of the teeth.

IV. CONDITIONS AT THE AGE OF THREE.

It is seldom that any malocclusion of the temporary teeth

[1] Read before the First District Dental Society, S. N. Y., Oct. 5, 1914. See disc., p. 616.



O.C. = occlusal curve.
A.B. = condyle plane.
D.E. = occlusal "

Fig. 1.

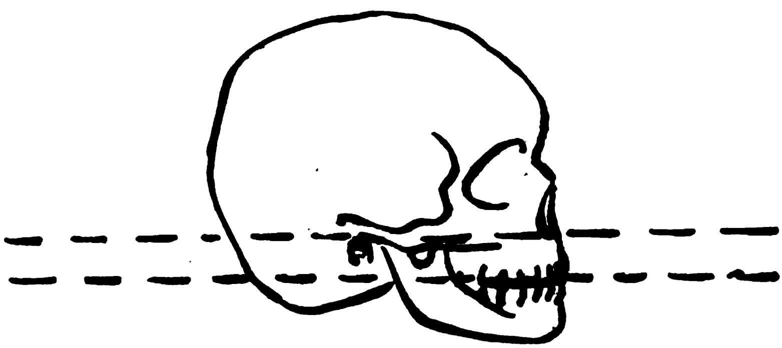


Fig. 2.

presents itself at this age, and the normal occlusal curve of infancy is so nearly a straight line that it might almost be considered such. There is but little overbite in the incisor region and comparison with the adult occlusal curve shows a marked difference (Fig. 2).

The difference is due to the factors, heretofore mentioned, being so much smaller in their dimensions. The fossa is not so deep, nor the eminentia so high, and consequently the condyle path is more nearly a horizontal line. The cusps of the teeth are much shorter, and the short ramus results in the condyle and occlusal planes being nearer together.

The further development of the head and face proceeds simultaneously for greater breadth and length and height, and yet there seem to be distinct periods when but one of these dimensions seems to be outstripping the others, in a manner similar to that which occurs in the general bodily growth; the child growing tall and lank between eight and twelve, afterward broadening out to good proportions. For the purpose of calling your attention to these periods and directions of growth, let the jaws be divided into several zones as follows:

1. The Incisor—Growth in this region results in greater breadth of the face and begins, about the age of four to five, to be evidenced by the gradual separation of the temporary incisors, and continues until the eruption of the permanent successors takes place.

2. The Molar—Previous to the time of their eruption at the ages of six to twelve and eighteen, the first, second, and third molars give the stimulus to further growth in the depth of the face.

3. The Bicuspid or Temporary Molar—The shedding of the temporary molars and the eruption of the following bicuspids results in an increased vertical growth, and is the first step in the development of the adult occlusal curve.

4. The Cuspid—The cuspids are the keystone of the "arch curve," and their eruption causes still further depth as well as breadth of the face.

A table of the eruption of the permanent teeth is now presented, that you may more clearly associate the period with the zone of growth as we proceed now chronologically.

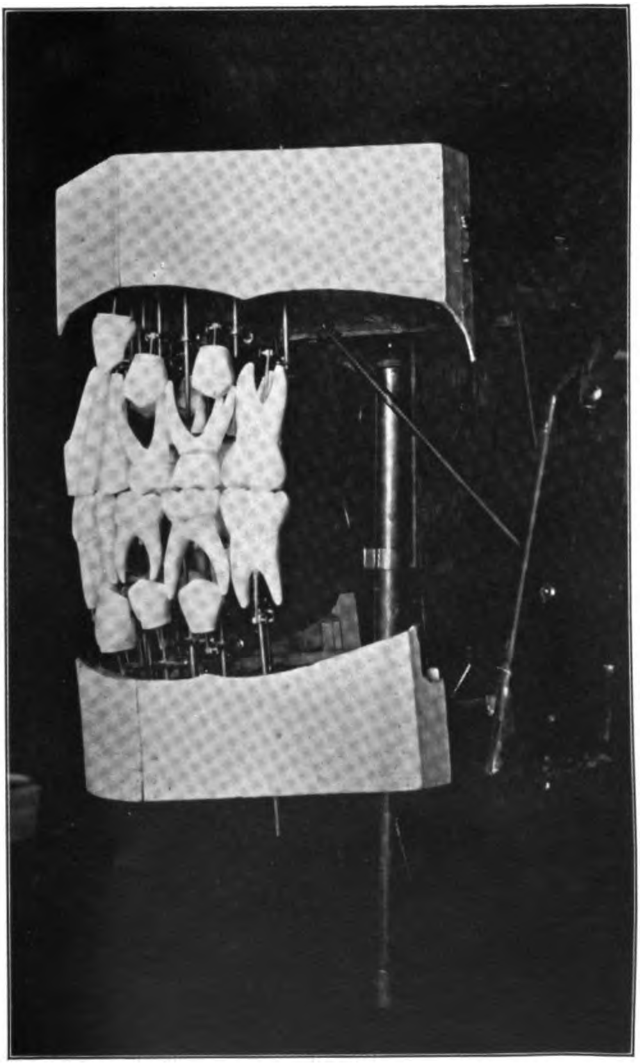


Fig. 3.

Age 6.—Note the position of the first permanent molars; they are in false or temporary cusp relation and the infantile occlusal curve is not changed.

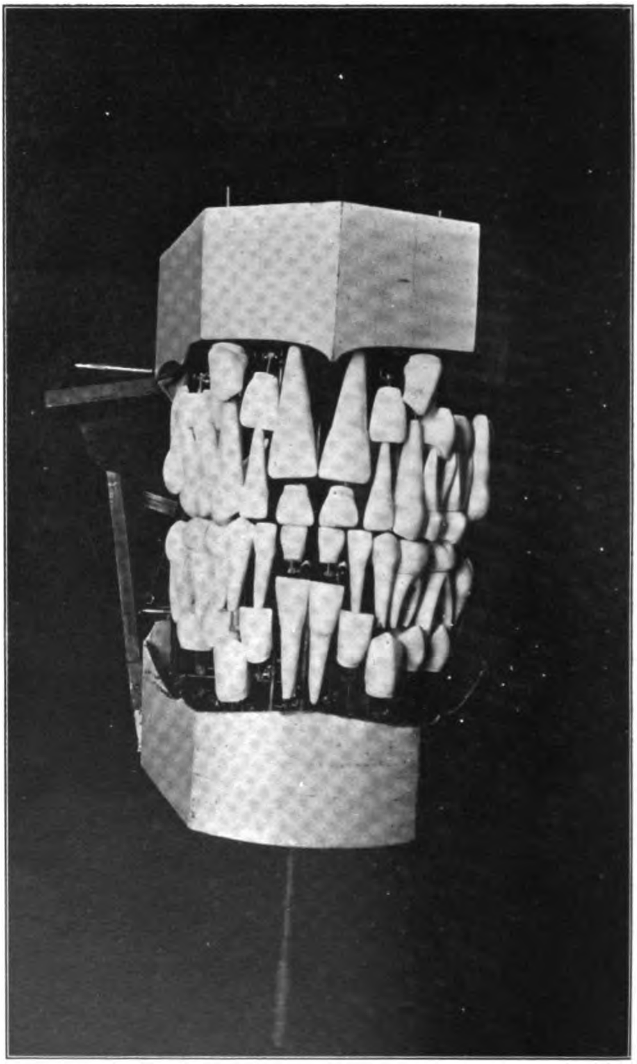


FIG. 4.

Age 5-6.—Note the increased width from cuspid to cuspid, the separation of the temporary incisors, and the wedged-shape arrangement of the permanent incisors and cuspids.

(*Cosmos, January, 1914.*)

Some notes on the dates of eruption in 4850 children under twelve years of age.

Compiled by Drs. W. W. JAMES and A. T. PITTS, London.

At Yrs.	Mos.	50% present
6	0	Lower 1st molars
6	3	Upper " "
6	6	Lower central incisors
7	6	Upper " "
7	6	Lower lateral incisors
8	9	Upper " "
10	0	Upper 1st bicuspids
10	6	Lower " "
10	6	Lower cuspids
11	0	Upper 2nd bicuspids
11	9	Upper cuspids
12	0	Lower 2nd bicuspids
12	0	Lower " molars
12	6	Upper " "

V. CHRONOLOGICAL DEVELOPMENT.

Age 6-10. With the eruption of the first molar, and the consequent forward growth of the jaws, there has likewise occurred a broadening in the incisor region as the permanent centrals force their way into place.

The position that the molars and incisors take at this time is not the one they are finally destined to assume; they have not yet erupted their full length, having come up only to the level of the " infantile occlusal curve," which still persists. The molars are in an almost vertical position, as viewed from the side, and the cusp relations are abnormal, as the lower molar is slightly more distal than the upper to its final position.

The important point to note here is the fact that the occlusal curve of the temporary teeth is not appreciably changed by the addition of the first permanent molars.

A study of the conditions that prevail in the incisor region just prior to the eruption of the permanent centrals shows very clearly one of the important diagnostic signs of growth—namely, the separation of the temporary incisors (Fig. 3). The wedge-shaped arrangement of the permanent incisors and cuspids gives a clear idea of the mechanical stimulus responsible for the increase in width.

Age 10-12. Before beginning the study of this important period and zone of development, let us review Black's figures as to the comparative antero-posterior diameters of the temporary molars and of the bicuspids which replace them.

BLACK'S MEASUREMENTS

		1st (mm.)	2nd (mm.)	
Upper	T. M.	7.3	8.2	15.5
	Bic.	7.2	6.8	14.
				1.5
Lower	T. M.	7.7	9.9	17.6
	Bic.	6.9	7.1	14.
				3.6

It will be seen that the added diameters of the upper molars exceeds that of the bicuspids by 1.5 mm., and the lower by 3.6 mm.

The question arises, Why has nature reserved more space here than is needed by the succeeding bicuspids?

In no other case has she done so.

This paper is an attempt to answer this in a reasonable way, and it is the formulation of several years' study and clinical observation.

With the eruption of the bicuspids there occurs a series of phenomena which marks the change from the flat occlusal curve of children to the more pronounced one of adult life.

The formation of the temporary molar roots is such that they serve to guide the bicuspids upward and *forward*, because the point of bifurcation of the lower, and trifurcation of the upper molars, is mesial to the center of the tooth, and the inclination of the distal root is greater than that of the mesial (Fig. 4).

The pressure of the oncoming bicuspids causes a rapid and pronounced elongation of these loosened temporary molars, and results in an opening of the bite which is the first step toward the adult occlusal curve. The first permanent molars and incisors, which, up to this time, have been only partially erupted, are temporarily left behind at the level of the child's occlusal curve (Fig. 5).

Then the first temporary molar drops out, the open bite being

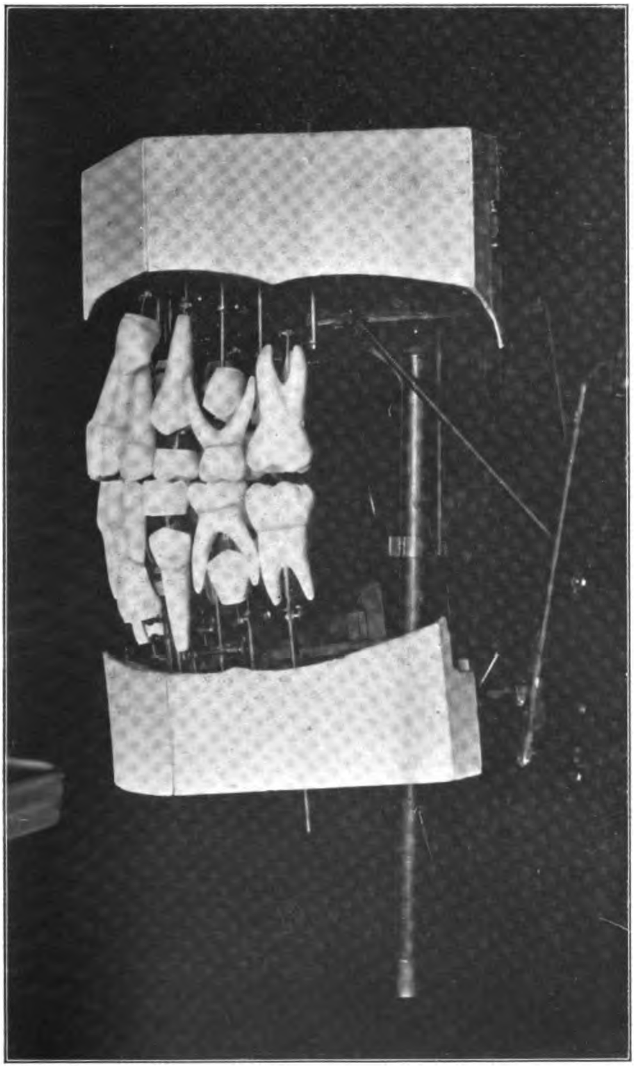


Fig. 5.

Age 10-11.—Note the elongation of the temporary molars, leaving the first permanent molars behind at their previous level; also the inclination of the distal roots of the temporary molars.

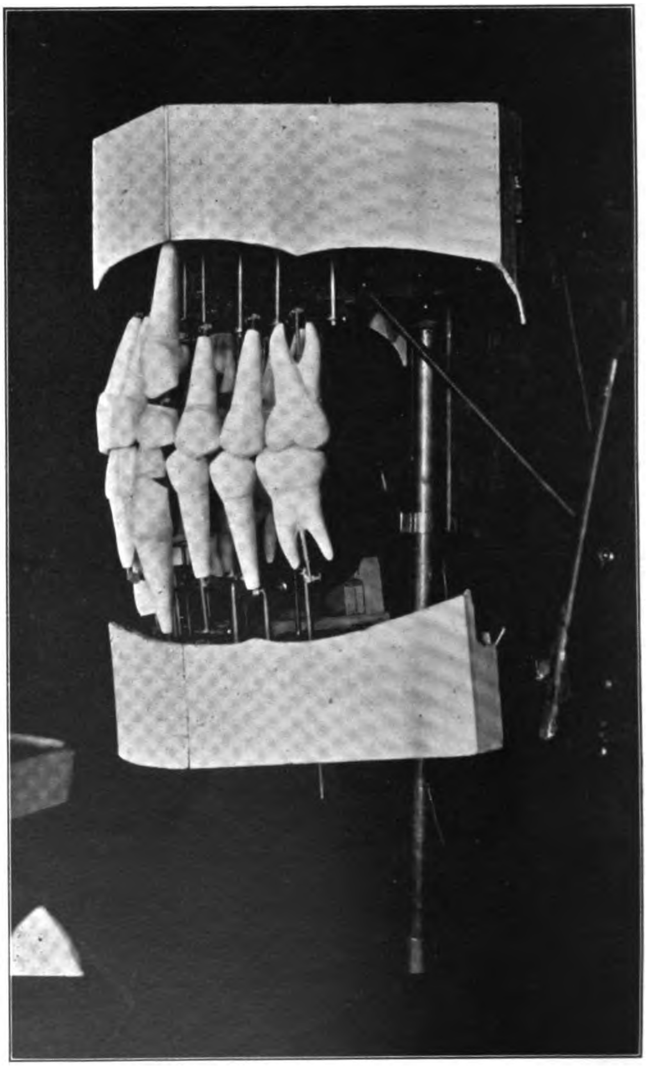


Fig. 6.

Age 11-12.—Note that the bicuspids have established the low point of the occlusal curve and the first molars have moved forward to close the space; they are in permanent cusp relation and the occlusal curve has commenced its upward trend.

held by the second temporary molars, and the first bicuspids erupt to their full length, just distal to the temporary cuspids.

The first permanent molars are now elongating, and with the second temporary molars moving forward to close up the space represented by the difference in the diameters of the first bicuspids and first temporary molars.

Then the second bicuspids displace the second temporary molars and come into position distal to the first bicuspids, and the first permanent molars move still further forward to close up the space again.

The lower molar must move further than the upper. Its crown *tips* mesially as it comes forward, and this elevates its distal cusps. As the upper and lower molars occlude again, the influence of the inclined planes of the cusps helps to bring them, for the first time, into perfect normal occlusion.

Since the upper bicuspids erupt generally from six months to a year earlier than the lower they have a chance to erupt further and establish the low point of the adult occlusal curve.

Meanwhile the incisors have erupted to their full length and normal relations with each other.

The eruption of the cuspids adds both breadth and depth to the face, and their coming serves to lock the other teeth into their permanent arch and occlusal relations.

This, then, is the period of accelerated vertical growth, and the bicuspid zone is where it starts. Coincident with these local changes, there has been a similar and proportionate vertical growth of the other factors mentioned—*i. e.*, a lengthening of the ramus and a change in its angle; the further growth of the eminentia articularis and consequent deepening of the glenoid fossa, resulting in a changed condyle path.

An analytical and disjointed account like this poorly conveys an idea of the harmonious, even course of development and the blending of the successive steps, and periods, and zones. It is not analogous to architectural or mechanical construction, but rather to the unfolding of a flower.

Age 12-20. From this time on, the development of the face is mainly in a forward direction, or depth, the stimulus being provided by the remaining molars (Fig. 6).

The movements of the jaw, guided and determined by the

dimensions and locations of the factors already in place, makes it impossible for the second and third molars to elongate beyond the extension of the established occlusal curve.

CONCLUSION.

The answer to the question concerning the comparative diameters of the temporary molars and bicuspids is as follows:

The development of the child is a slow process extending over years.

The temporary teeth are too small to serve the adult, and the permanent teeth too large for the child.

The increase in the measurements of the different structures mentioned is slow and very considerable in amount.

This occurs in order that the first permanent molars may supply the additional masticating surface required by the increase in the depth of the face occurring at that age, serving with the temporary molars, as temporary teeth, during the transsitional period; occupying a position which does not conflict with the infantile occlusal curve and the function of the temporary teeth. This plan is in harmony with the smaller dimensions of the parts at that age. When the temporary molars are lost the first permanent molars elongate, keeping pace with the rapid increase in vertical growth of the child, and move forward and *tip* into their true position in the adult occlusal curve.

Attention is called to the occlusion of the first permanent molars from the time they erupt until they assume their definite true adult relations just after the eruption of the bicuspids; errors in diagnosis would follow if this condition were not considered.

The division of the age of growth into periods, characterized by the predominating influence, and the jaws into zones where these are particularly manifested, argues for early interference, and gives a clearer idea of the kind of development needed to bring the backward child up to the standard demanded by the age. Normal occlusion of the adult is far different from any of the stages of normal development; this is particularly evident in the case of the occlusal curve because that is non-existent until about the eleventh or twelfth year.

The temporary molars should not be extracted at the first sign of loosening, but should be allowed to stay in place until

they practically fall out, in order that the " bite " may be opened and the vertical growth secured by their elongation.

Congenital mesial or distal mal-relation of the mandible is very rare, and is seldom seen before the age of four or five. Consequently there is a time when this begins to depart from the normal relation.

The direct and probably the only mechanical cause of Class II., and possibly Class III., malocclusion is the failure of lateral growth in the temporary cuspid region. The narrow upper cuspids, closing outside the lower arch curve, prevent it from widening and tend to force the mandible into a distal position. Of course, there may be an *ultimate cause* behind this one, such as the influence of heredity, the willful imitation of a parent's deformity, or the presence of adenoids or enlarged tonsils, and the consequent habits of mouth breathing, or improper positions in swallowing. Therefore, to prevent Class II. or Class III. malocclusion, spread the temporary cuspids at the indicated time.

The theory is advanced that the size, shape, and angle of the eminentia articularis of the adult is governed or molded by the repeated excursions of the condyle during the functioning of the mandible. Reasoning from this hypothesis, no case of malocclusion, that has passed the age for growth in this region with teeth in malposition, can have developed a normal eminentia, or have a normal condyle path; and, further, no such case can ever be made normal by attempting to change one of the factors alone —*i. e.*, the positions of the teeth.

The importance of the occlusal curve must be recognized and appreciated. It does not begin to form until the bicuspids erupt; it cannot develop normally if the mandible is in malrelation, or if individual teeth do not properly occlude. Cases of malocclusion of advanced age cannot be held in normal anteroposterior relation unless this occlusal curve has been carefully established in accordance with the mechanical and physical demands of all the factors involved.

The next great step in this particular field of dentistry will be a complete mastery of the physical and mechanical laws that govern the development of the jaws and their functions; a work begun by Bonwill and recently further advanced by the admirable work of Gysi and others.

A FURTHER STUDY OF THE EFFECTS OF ACID MEDIA ON NATURAL EXTRACTED TEETH[1]

BY ALFRED P. LOTHROP AND WILLIAM J. GIES,

WITH THE COLLABORATION OF

HENRY W. GILLETT, CHARLES C. LINTON, ARTHUR H. MERRITT AND HERBERT L. WHEELER.

I. INTRODUCTION.

Mr. President, Ladies and Gentlemen: The presentation to you of the annual reports on our dentochemical research has become a very agreeable duty. It is a great pleasure for us to perform this function, not only because of your gracious reception of our reports, but also because of our increasing interest and absorption in chemical problems of dental science.

During the past year we have extended our work along some of the lines indicated in our report last fall. Our results have been far too numerous, however, to permit of their detailed oral presentation and discussion at a single session of this society. It has been necessary, therefore, to select a few features for your consideration to-night, and to reserve most of our data for publication, under your auspices, as a supplementary report.[2] Accordingly, with the approval of the president and the Research Committee, we shall present, to-night, simply the results of our further study of the effects of acid media on natural extracted teeth.

II. PURPOSE OF THE EXPERIMENTS.

Permit me to remind you of the status of our previous ex-

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[1] This report was presented at a meeting of the First District Dental Society of New York, at the New York Academy of Medicine, November 2, 1914. The senior author, in coördinating the various parts of the report, explained extemporaneously the general purpose and plan of the experiments, and also the nature of the several treatments to which the teeth had been subjected. The collaborators stated their respective dental findings after the oral description, by Dr. Gies, of the corresponding treatments. The experiments were conducted in the Biochemical Laboratory of Columbia University, at the College of Physicians and Surgeons, New York. See disc., p. 629.

The previous papers, in this series, were published in the *Journal of the Allied Dental Societies:* 1910, v, p. 262; 1911, vi, pp. 65, 289, 297, 323 and 334; 1912, vii, pp. 199, 397 and 410; 1913, viii, p. 283.

[2] This supplementary report will be published in a future issue of the *Journal of the Allied Dental Societies.*

periments in this connection, by quoting some remarks from our report last fall.[3]

In his address a year ago (1912), the senior author made the following statement:[4] "Several months after your president, Dr. Howe, invited me, in 1909, to take a practical interest in the subject of dental caries, I had the pleasure of meeting the members of your Research Committee at an informal session. Although I frankly stated that I knew too little about the subject to speak learnedly regarding any phase of it, I presented several ideas regarding possibilities and plans. I suggested (1) that dental caries might be due to the action of micro-organisms upon carbohydrates on and between the teeth, *localized* in both cases by 'adhesive mucin masses,' or by other mechanical fixations.[5] I also expressed the belief (2) that the disintegration of 'adhesive mucin masses,' or their prevention, might be an important feature of prophylactic treatment against dental caries; (3) that both disintegration and prevention might be accomplished satisfactorily with dilute acid; and (4) that 'food acids' (the typical fruit acids and their acid salts) might be effectively used for such purposes.[6] (Page 284.)

If mucin plaques favor the fixation of bacteria and the lodgment of carbohydrate on the teeth, with consequent local production and focal action of fermentation-acid, it is obvious that suitable means to prevent the deposition of mucin plaques, or to disorganize them after their formation, might afford effective prophylactic intervention. In our preceding annual reports we have emphasized the special virtue of food-acid media for such a purpose (to "keep the teeth clean"), as against the supposed advantages of alkaline dentifrices, because of (a) the chemically precipitative (curdling) effect of food-acid media on mucin solutions (thin, viscid, or semi-solid); (b) the comparative non-adhesiveness of mucin curds; (c) the ease with which the mucin curds or flakes can be brushed from dental surfaces; (d) the destructive effect of the acid substances in such media on the oral micro-organisms; and, incidentally, (e) the temporary though helpful *stimulating* effect of such acid media on the after-flow of saliva. Our emphasis on the utility of media of this kind for such purposes has been warranted by the universal dietary use of fruits and fruit juices. If we may *eat* apples and

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[3] Lothrop and Gies: *Journal of the Allied Dental Societies*, 1913, viii, p. 284.

[4] Gies: *Ibid.*, 1912, vii, p. 400.

[5] The suggestion regarding microörganisms was a mere restatement of the prevailing physiological opinion, but the speaker imagined the idea about *local* fixation of microörganisms and carbohydrate by "adhesive mucin masses" was new. He soon learned that Dr. Kirk had previously emphasized the same conception.

[6] These views were based on many years of experience in the work of precipitating mucins and mucoids, on the general physiological knowledge that salivary secretion is stimulated by fruit juices, and in the opinion that acid fruit juices could do no damage to enamel during their *transient* appearance in the mouth.

oranges without fear of damage to the teeth, what can be the objection to reasonable application of the same kinds of juices as frequently to the teeth with a brush? (Page 291.)

In our experiments on the effects of food-acid media, *vinegar* has been occupying the most prominent place because of the convenience and satisfaction with which it may be obtained abundantly, conserved perfectly, and used accurately. Furthermore, by testing our prophylactic theory with the food-acid medium which, next to lemon juice, appears to possess the highest acidity (is "one of the most dangerous," let us assume), we shall surely avoid certain errors of experimentation which often ensue from the selection of specially favorable conditions for the establishment of a particular conclusion. "Vinegar seems to be one of the most dangerous food-acid media for employment as a dentifrice." Granted! That is the best reason for its use in our experiments. If we find that *it* is harmless, the finding will be, in effect, a blanket-conclusion! (Page 292.)

That mucin is readily precipitated from its salts and from saliva by the acid substances normally present in fruit juices was shown in one of our demonstrations last October (1912). That food-acid media must vary in this power is obvious. . . . Precipitation was induced with acid solutions at the following limits of dilution: Lemon juice, 1 (part) in 256 (parts of water); vinegar, 1 in 128; orange juice, 1 in 32; apple juice, 1 in 16. Below these limits precipitation did not occur. (Page 292.)

In brief, we began the work, described a year ago, (1) on the *assumption* that it is important, for the prevention of dental caries, *that the teeth be kept clean* and (2) in the ***knowledge*** that *food*-acid media are efficient cleansing agents, particularly because of their disintegrative effects on mucinous deposits of the kind that occur on teeth.[7]

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[7] This assumption, "that it is important, for the prevention of dental caries, *that the teeth be kept clean,*" is not an assumption that *keeping the teeth clean* can or will prevent caries in *every* mouth and under *all* conditions. Last March the speaker made the following statement on this point (Gies: *Journal of the Allied Dental Societies*, 1913, ix, p. 320):

"The main point in my proposal of the use of food-acid media as dentifrices was the *belief* that they might be useful in 'keeping the teeth clean,' by effecting, in particular, the chemical precipitation of mucin from adherent mucinate smears or films on the teeth, thus causing the disorganization of such plaques and also facilitating the mechanical removal of the flocculent, non-adhesive mucin? I have also thought that the solvent action of such media on 'hard tartar' might be advantageous as a cleansing process, and that their acidity might be serviceable in the treatment of pyorrhea. . . .

"I have never suggested that vinegar, or any food-acid medium, is or can be a 'cure all'—I have proposed merely that the teeth may possibly be 'kept clean' with it. That such a food-acid medium might be most effective if used only now and then, or before or after the application of an alkaline dentifrice, has been occasionally suggested in my informal statements on this subject; just as I have indicated the probability that food-acid media might be wholly unsuitable as dentifrices in various types of cases, *e.g.*, erosion. (These matters require *investigation,* not decision by intuition. We are not proceeding as rapidly as might be desired, in these directions, with learned statements as to 'what's what,' because we are going to *find out first* and explain afterward.)

"I have repeatedly said that I cannot believe that 'keeping the teeth clean' is the only, or even (in many cases) the main, *desideratum* for the prevention of

Our preliminary experiments on the effects, on natural extracted teeth, of diluted vinegar in particular, were undertaken, as stated a year ago, to determine whether the reasonable use, as a dentifrice, of such a comparatively strong food-acid medium (obviously highly effective as a cleansing agent) would be productive of any *deleterious* effects; and, if so, of what nature and to what extent. Our results indicated that vinegar, diluted (1:1) with water and applied to teeth twice daily for six months, did not induce injurious effects on enamel.[8] Our experiments since the presentation of our last report have given us *similar data for longer periods of time* and also for several additional acid agents of physiological importance. To these further experiments we shall now refer in detail.

III. General Plan of the Experiments.

Methods. Each set of teeth of the twelve that were subjected to treatment was carefully examined by one of our four dental collaborators just before the teeth were embedded in paraffin in zinc boxes, by the method described in our last report.[9] Each tooth was so embedded in the paraffin as to leave its crown exposed. After their appropriate fixation in the "artificial jaws," each set was again submitted to the dental collaborator who had previously examined it, so that he might determine whether or not the embedding process had induced any changes in the condition of the enamel and fillings, and whether the teeth were in a satisfactory state in general for the inauguration of treatment with a dentifrice.

The treatment of the several sets of teeth was conducted in accord with the general method described in our last report.[10] Departures from this procedure will be noted in the special de-

dental caries. The intrinsic quality of the teeth themselves, I have often urged, must be considered. Several years ago I referred in this connection to Erdheim's work—work showing the dependence of the condition of the teeth upon the nutritional state of the individual. (Gies: *Journal of the Allied Dental Societies*, 1912, vii, p. 214.) Last May, and again in October, I alluded to similar facts. Besides proceeding with our studies of food-acid media, a clear indication that I feel that much more must be learned in this regard, we have also been conducting experiments on the *relation of internal secretions to the condition of the teeth*—a nutritional investigation in progress under the auspices of the Dental Society of the State of New York."

[8] Lothrop and Gies: *Journal of the Allied Dental Societies*, 1913, viii, p. 306; Merritt: *Ibid.*, pp. 365 and 377; Linton, *Ibid.*, pp. 365 and 376.

[9] Lothrop and Gies: *Journal of the Allied Dental Societies*, 1913, viii, pp. 304-5.

[10] Lothrop and Gies: *Ibid.*, p. 305.

scriptions below. The teeth were brushed twice each day, the shorter daily interval being at least eight hours in length. Each kind of treatment was applied with a particular brush, which was used for no other treatments. During the periods between brushings, each set of teeth was kept, at *room* temperature, in a moist chamber of the kind and under the conditions described last year.[11]

The experiments were conducted at *room* temperature, rather than at *body* temperature, because of the fact that the temperature of a liquid dentifrice as commonly used, in contact with the teeth, is practically room temperature. Although the temperature of the teeth in the mouth is higher than room temperature, the ordinary application of a dentifrice materially lowers the superficial temperature of the teeth. There is no reason to believe, therefore, that the difference between the temperature of a liquid dentifrice on the teeth in the mouth, and the room temperature of our treatments, could account for any injurious action at the former temperature that would not have been evident at the latter. Naturally, we could not ascertain in this study the effects of all possible influences, and among those we ignored were the influence of temperature. We propose to make a special test of this point, with others, in an extension of this work.

Of the artificial environment in which the teeth were kept, we may say just as truthfully now, we think, as we did a year ago (p. 305), that "the conditions of these experiments were such as to favor (a) the *maximum* destructive effect, if any, of the materials used as dentifrices, and (b) the *minimum* protective influence of the saliva. The normal conditions in the mouth, it seems to us, would permit less destructive activity by the acid media (if there was any at all), and would possess greater protective potential."

Some of the teeth contained fillings, as is noted in the special descriptions below. We sought to determine, with the filled teeth, the effects of acid media not only on enamel at the edges of fillings, but on fillings themselves, particularly at their surfaces of contact with the teeth. We said on this subject a year ago:

"It is conceivable that food-acid, if not particularly destructive of

[11] Lothrop and Gies: *Journal of the Allied Dental Societies*, 1913, viii., p. 305.

normal enamel, might be strongly disintegrative of enamel along the line of contact with filling materials such as amalgam. Electrolytic changes might be supposed to occur to an appreciable extent on both sides of the dividing line—changes, it might be inferred, which would undermine the fillings involved, if nothing more generally harmful were accomplished."[12]

At intervals during the continuance of the treatment, each set (except two to be indicated) was resubmitted to the dental collaborator familiar with the initial condition of the teeth, for such examination as he might wish to make in order to determine approximately the time of initiation of any injurious or significant effects. A concluding examination has just been made by each collaborator.

At the speaker's request, the dental collaborators have proceeded independently with their examinations, and have refrained from stating to Dr. Lothrop and the speaker any of the recorded facts pertaining to the preliminary condition of, and the subsequent effects upon, the teeth and fillings. The reports by the dental collaborators have been written and are about to be read to you. The speaker will learn for the first time to-night, since the presentation of the reports by Drs. Merritt and Linton last fall, whether any effects have been observed. In harmony with this policy of strictly independent observation, the dental collaborators, in turn, were kept by us in entire ignorance of the nature of the treatment to which the teeth have been subjected. Our dental friends will learn the details in this connection to-night, for the first time, as the speaker states them, immediately before the collaborators read their prepared reports.

[The apparatus and accessories used in the application of the treatments, the coördination of the procedures involved, and the sets of teeth referred to below, were shown by the speaker as a part of the oral report.]

IV. Experiments 1-5.

First experiment. Dental collaborator: *Dr. Henry W. Gillett.*

Teeth: Sets A and B—two similar series of ten each; each tooth contained a filling. Each set of ten teeth was divided, by a transverse glass partition embedded in the paraffin, into two groups of five, referred to below by Dr. Gillett as A-1 and A-2,

[12] Lothrop and Gies: *Journal of the Allied Dental Societies*, 1918, viii, p. 304.

B-1 and B-2. A-1 and B-1 were closely analogous in kind and condition; A-2 and B-2 were similarly related. The glass partition prevented the liquids applied to one half of a set from running over to and around the other half.[13]

Quotations: From a letter by Dr. Gies, to Dr. Gillett, Jan. 17, 1914; discussion of preliminary conditions.

"I am sending you herewith twenty teeth which have been examined for us by Dr. Merritt and declared teeth with 'sound enamel and on which the enamel is worn very little or not at all.' . . . The teeth were taken from the jaws of cadavers by sawing through the bones and then carefully separating the bone remnants, when that was convenient, or permitting the adherent bone to remain. We have thus prevented any damage to the enamel of the teeth that might be caused by the ordinary method of extracting them with forceps.

"I am sending the teeth to you as a member of the Research Committee, with the request that you, or associates of your selection, introduce into the teeth a number of typical fillings, in order that we may continue to study the effect of acid and alkaline media on the condition of the teeth and fillings, and the connections between the two. The teeth we have been using for this purpose for some time are teeth in which decay had occurred, the cavities having been suitably filled. We are assuming that in the case of perfect teeth, cavities could be drilled in the most suitable places and fillings could be inserted perfectly, thus affording us unusual opportunity to study the sound enamel at the lines of union with the fillings. . . .

"As the teeth will be directly compared under identical general conditions, but subject to specific influences, let me suggest that fillings of a given kind be inserted in pairs of teeth of approximately the same surface exposure. The fillings should be in approximately the same position, and have practically the same extent, in each pair of teeth selected.

"Will you kindly also make an expert examination of the teeth over the entire enamel surface of each as well as on the edges of the fillings, doing just as Dr. Merritt did last year, so that you could tell whether or not, in a re-examination of the teeth, there had been any change whatever at any point on the tooth surface?

"We shall ask you to give us no information on this point at any time, in order that our own findings may be obtained independently of any knowledge that you may possess."

TREATMENT: *Intended to show primarily the effects of fer-*

[13] This partition was not inserted at the beginning of the experiment; but after Dr. Gillett's first examination (April 18), when effects were clearly increasing, we placed the partitions in position in order to obtain the differentiation mentioned above.

mentation of glucose on teeth brushed with vinegar (diluted with an equal volume of water) and kept wet with saliva; also the effects of dilute vinegar on teeth "protected" with saliva.

Procedure: Started, February 27, 1914; practically eight months prior to this meeting. Each set (A and B) was brushed twice daily with dilute vinegar.[14] An abundance of saliva was then expectorated on each set and distributed with a brush over and around each tooth.

At this point, in each brushing, the sets were treated differently: *a small amount of pure, neutral glucose was sprinkled on the teeth of set B, dissolving at once in the saliva.* The sugar (salivary solution) was then distributed with a brush over the teeth in set B. Half of each set (A-2 and B-2) was then covered with a strip of wet muslin, which, by capillarity, held the excess of saliva closely against the teeth at all points on their surfaces, simulating, in this way, the oral environment of the teeth at their points of contact with each other and with buccal, labial, and lingual surfaces. Half-sets A-1 and B-1 were not covered, the salivary fluid having had full opportunity in every case to trickle, to some extent, from the tops and sides of the teeth and slowly to evaporate into the space under the cover of the container.[15]

For the reader's convenience in studying the appended re-

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[14] Because of the importance of this detail we repeat it here from last year's description, although our general statement above, under "Methods," covers this point (Lothrop and Gies: Loc. cit., p. 305.):

"An ordinary flat toothbrush with tufted bristles was used for the application of the dentifrices. At each application the brush was held a moment in running water, the bulk of the suspended water dislodged with a jerk, and then ten drops of diluted vinegar (1:1) or of a popular, slightly alkaline, antiseptic dentifrice were allowed to fall on the wet brush from a dropping bottle. The teeth were vigorously and systematically brushed for a period of 10 to 15 seconds. The brush was then rinsed in running water, and the teeth washed with the water that was suspended in the brush. The excess of water on the teeth ran over the sides of the 'artificial jaw.' The teeth were washed with three fresh supplies of water in the brush. Finally, residual water was drained from the teeth by simply tilting the box. Saliva was then expectorated on the teeth and distributed over them with the clean brush."

[15] At the beginning we used cotton-wool covers, but the acidity of cotton wool and the difficulty of cleaning it, together with the consequent inconveniences, induced us to use muslin strips instead. These were substantial covers that could be thoroughly cleaned and repeatedly used. The acidity of the cotton wool employed at the beginning was removed by adequate treatment with dilute solution of sodium carbonate. The muslin strips were washed with soap. The liquids on teeth A-1, and in and under the muslin covers of set A-2, were always continuously alkaline to litmus; on those of B-1 and B-2 (treated with glucose) the initial alkaline reaction to litmus was soon replaced by acidity to litmus, due to the products of fermentation of the added glucose.

port by Dr. Gillett, the essentials among the foregoing details are summarized in the following tabular arrangement:

Sets	Teeth[16]					Treatment
A–1	a	b	c	d	e	Vinegar; saliva; *no glucose;* uncovered.
A–2	f	g	h	i	j	Vinegar; saliva; *no glucose;* covered with muslin.
B–1	a′	b′	c′	d′	e′	Vinegar; saliva; **glucose**; uncovered.
B–2	f′	g′	h′	i′	j′	Vinegar; saliva; **glucose**; covered with muslin.

DENTAL EXAMINATIONS: *Report by Dr. Henry W. Gillett.* The treated teeth were received by me for inspection, on April 18, July 1, and October 29.

Findings of examination of individual teeth will more conveniently appear later in this report.

In the twenty teeth Dr. Leslie E. Palmer and I inserted two fillings of each of the following materials—gold inlays, gutta percha, Ames's Black Copper Cement, Stanley's Red Copper Cement, Ames's Pearl White Inlay Cement, and four each of Ames's Berylite and Fellowship Alloy.

Effort was made to arrange the teeth in pairs, matching approximately in quality and condition, and to insert the same kind of filling in a similar manner in both teeth of each pair. In several instances it was easy to identify each tooth of a pair as having been from the same jaw. No effort was made to insert typical fillings as regards location or occlusal shape, but there was an effort to insert each filling so that its margins would lie in sound enamel, to make those margins as perfect as possible, and to so place the fillings as to expose them to the full action of any media that should be applied to them with a brush.

These teeth, when returned to Professor Gies, became sets A and B of to-night's exhibit. Until to-night I have known nothing at all of the treatment they have undergone. I saw them for a hasty inspection April 18, again on July 1, and for a careful examination October 29 and 30.

On April 18 I made the following memorandum: " Inspection shows marked effect on enamel and cements of cuspid end

[16] The partitions were placed between teeth e and f (A) and e′ and f′ (B). A-1 is a " control " on B-1 respecting effects of glucose on the *uncovered* teeth; A-2 is a control on B-2 respecting effects of glucose on the *covered* teeth. A-1 and A-2 give independent information on the effect of the dilute vinegar on the teeth and fillings under conditions that approximate those of the oral environment.

of set B. Enamel is like that of so-called white decay cases, copper and zinc oxyphosphates much dissolved." (This would be set B-2 of the following paragraphs.)

My memoranda made July 1 indicate that the effect of whatever treatment they were receiving was still chiefly confined to the set B-2. That in this set the copper cements were rapidly dissolving, and that the other cements at the margins of inlays were showing the same condition. I noted on that date the earlier stage of the peculiar dark staining that will be referred to later in reporting my findings on October 29.

On examination October 29 I found the twenty teeth divided into two sets of ten each, marked A and B, and each set of ten being subdivided into two divisions of five each.

I have been asked to report concerning each subdivision of five. To facilitate indentification, I shall give those in Box A the further designation of A-1 and A-2, and those in box B that of B-1 and B-2. Sets A-1 and B-1 are the sets of five in the end of their respective boxes that has its letter scratched in it, and sets A-2 and B-2 are the sets in the unmarked end of the box.

In making my initial record I made memorandum of general appearance and condition of each tooth, and of all noticeable defects. The present appearance of the individual teeth in each set of five is so similar that the individual defects fade into insignificance.

In each set there were teeth so perfect that they would receive that designation in any of our office examinations. There were others with tartar, with stains, with enamel checks and cracks, and sets A-2 and B-2 each had two teeth from which sections cracked off while the cavities were being prepared, and which were cemented in place, in each case using the same cement with which the filling was made, and both had teeth with the markings of arrested enamel development.

The tooth surfaces in sets A-1, A-2, and B-1, show little physical change from the conditions of January 1914. In sets A-1 and A-2 the enamel surfaces present conditions simulating that of well-kept mouths, except that in one of the molars of set A-1 the brown tobacco-stained condition originally present has been brushed off on the buccal surface only, the lingual surface apparently having had less brushing.

In sets B-1 and B-2 there is a peculiar staining apparent. It is different from anything I ever saw in the mouth. In B-1 it is not very pronounced, except in one bicuspid, which has a longitudinal crack, which would probably result in its dropping apart if removed from its wax investment, and which also has a channel around the filling margin. These two conditions expose the dentin to direct action of any fluid media applied.

In B-2 a much more pronounced staining of the same character is apparent wherever the enamel still remains intact. Each tooth in set B-2 is apparently changed in color all through its substance. Enamel that remains intact is polished, but its color is so nearly that of the oxidized amalgam filling remaining in one of those teeth that I had to scratch the surface of the filling in order to distinguish it from the surrounding enamel. The color of this amalgam filling is that normal to the average mouth.

In set A-1 the fillings remain nearly perfect. In this set there is one amalgam, one gold inlay, one red copper cement, and two Ames's Berylite. Wherever enamel margins are actually exposed around the fillings they show a slight disintegration. The red copper cement has wasted a little, and become roughened. The Berylite has done as well, or better, as regards waste and color change, than would be expected in the mouth for a similar period.

In set B-1 the changes are more marked. Around the amalgam there is little change—around the gold inlay at points where there was no overlap, there is a channel apparently due to wasting of cement and enamel. The red copper cement has wasted considerably more than in the corresponding tooth in set A-1, and a wide channel has opened around half its margin. Both the silicates have turned a dirty yellow, and their margins show channels.

It is in sets A-2 and B-2 that we have the most pronounced relative differences. I have already noted the condition of the enamel of both sets. In A-2 the Ames's Copper Cement has wasted quite a little—the Ames's Inlay Cement a very little. The amalgam, gold, and Ames's Crown and Bridge remain practically as they were when inserted.

In B-2 there has been an astonishing change. All the fillings are gone, except one small amalgam, which remains as perfect

as I would expect it to be in the mouth in a similar position. The gold inlay dropped out October 7, Dr. Gies informed me, leaving some cement in the center of the cavity. The tooth, showing evidence of arrest of enamel development around its tip, has lost that tip, while the corresponding tip in set A-2 remains practically as it was in the beginning. In addition to the staining and discoloration of the enamel already noted, the dentin, wherever it has become exposed, has turned black, and become soft. In its wet condition it is about the consistency of a half-dried cheese rind. Some of the teeth are breaking up and becoming disintegrated. Wherever cross sections of enamel are exposed they turn white under the partial drying due to exposure for careful examination.

The broken cusps previously referred to as having been cemented to place, have become detached and loose, while in set A-2 they remain in place with no noticeable defect of the cement.

Several of the teeth came from a jaw which showed indications of being the so-called soft teeth. There was that general white appearance to which we apply the term chalky. Others showed evidence of notable arrest of development. Others had a recognizable tobacco stain, indicating that they came from the same jaw.

COMMENT: *By Dr. Gies, on Dr. Gillett's report above.* On July 1 I sent to Dr. Gillett a letter from which I quote the following:

"I am sending herewith the two sets of teeth which were filled by you and which have been subjected to various treatments by us daily since their receipt. The glass partitions merely mark off sharply the two halves of each set and prevent the small amounts of liquids applied to (and present on) one half from running over to and around the other half. At one end of one set (B-2) we have noticed, during the past few days, a very decided discoloration. I have assumed that possibly this discoloration is due to the very obvious dissolution of the black filling in the second tooth from the partition (g'). The tooth at one end (j'), which has lost a piece that had been cemented into it (as well as the filling), lost the filling slowly; and finally the piece which has been removed was dislodged. The piece was dislodged, *not during* the process of brushing, but was found on the paraffin beside the tooth a few days ago. These statements avoid any indication of our *treatment* of the teeth, in accord with our understanding."

Memoranda on effects observed. The essentials in our gen-

eral observations may be briefly summarized from our notes, as follows:

(February 27, 1914.—Treatment started.)

March 7.—Teeth treated with glucose (B-1, B-2) *began* to appear somewhat "chalky" at points on their surfaces. Teeth A-1 and A-2 were apparently unaffected.

May 10.—Black filling in tooth g' (B-2) seemed to be diminished over entire surface. Effects noted March 7 much more pronounced.

June 3.—White filling in tooth j' (B-2), dropped out.

June 15.—Piece in tooth j' (B-2), cemented in, dropped off.

July 18.—Last portion of black filling in tooth g' (B-2), which had been diminishing daily, disappeared. Whole set (B) markedly affected.

August 16.—Red copper filling in tooth f' (B-2) diminished gradually to a very small residue. Half the tooth broke off during brushing treatment (not due to impact of hard part of brush or other accident). Teeth in set B showed steadily increasing effects—teeth B-2 being "chalky" and brittle, particles appearing to come away during the daily brushings. The red filling in tooth d (A-1), the black one in g (A-2) and the white one in j (A-2) exhibited signs of slight alteration on the surfaces and at the edges.

October 7.—Gold filling in tooth h' (B-2) came out while the set was being brushed (not due to impact of hard part of brush or any accident).

I never asked Dr. Gillett or any one anything about the character of the fillings and purposely kept myself in ignorance of their chemical nature. I assumed, however, that the black cement contained such metals as mercury, copper and silver, or all of them, and ascribed the discolorations of teeth B-2, referred to in the quotation from my letter dated July 1 and discussed by Dr. Gillett, as due to the influence of compounds of such metals. There were "mirror effects" (reduction) in the cloth cover, which appeared to justify some of these assumptions. I made no chemical tests, however, preferring to keep in the dark on this matter until to-night. I hope, however, to go into all this later.

Reply: By Dr. Gillett, to the foregoing comment by Dr. Gies.

You will all recognize that the black cement was Ames's oxyphosphate of copper.

As I examined those teeth carefully, the color impressed me as something different from the discoloration of copper. We are all familiar with the discoloration from copper that apparently precipitates on the tooth after it has been separated from the filling, but this color seems to extend all through the substance of the tooth. It does not seem to me to have been due to the copper, and I am inclined to suspect it is due to the glucose or a combination of the glucose and something else.

Second experiment. DENTAL COLLABORATOR: *Dr. Arthur H. Merritt.* (See also experiments 4 and 5.)

TEETH: Sets C, D, and E—three similar series of ten each; *no fillings.*

Quotation: From a letter by Dr. Gies, to Dr. Merritt, March 30, 1914: reference to preliminary conditions.

"The bearer will hand you a number of teeth which have been obtained here from cadavers in our dissecting room. Will you kindly repeat the examination described in your letter to me of January 5 (fourth experiment), *i. e.*, please return the teeth divided into three groups: (A) Enamel sound, (B) enamel fractured, (C) enamel decayed. Kindly also subdivide groups A and B into (a) those on which the enamel is considerably worn without exposure of dentin, (b) those on which the enamel is worn very little or not at all, and (c) those with enamel worn through and exposing dentin. . . . The teeth have been kept moist with plain water since their removal, in order to prevent as far as possible fractures due to desiccation."

The teeth were returned on April 4. The thirty selected for our tests were taken mainly from the group designated by Dr. Merritt "those (c) with enamel worn through and exposing dentin," with a few of "those (b) on which enamel is worn very little or not at all."

TREATMENT, IN TWO PHASES. First phase: *Intended to determine whether water alone had any noticeable influence.* Second phase: *Intended to show the comparative effects of (a) water, (b) water containing carbon dioxid, and (c) water holding an abundance of salivary mucin (mucin not mucinate!)* [No other treatment; no saliva added.]

Procedure: Started, April 18, 1914; practically six and one-half months prior to this meeting.

First phase: April 18-June 29; two months and a half. Each set of teeth was kept wet under cotton-wool covers. The teeth were brushed gently about *once a week,* with tap water, when the cotton covers were renewed. (From April 4 to April 18 the teeth had been kept wet under cotton covers but had not been brushed.) The acid in the cotton wool was completely flushed out with water prior to its employment.

Second phase: June 30-October 29; four months. Each set was brushed twice daily with tap water. The *differences* in the treatment of the teeth, after the uniform brushings and during the intervening periods, are indicated in the following summary:

Sets	Teeth	Differential treatment.
C	1—10	Tap water added.
D	11—20	Thick suspension of mucin smeared over the crowns.
E	21—30	Carbon-dioxid water added from a siphon.

After the addition of each liquid, each set of teeth was covered with a wet muslin strip, and more of the corresponding fluid was placed on the muslin cover. This treatment insured the continuous presence and action of an abundance of the medium *throughout the intervals between brushings,* without "protection" of the teeth by saliva.

The "thick suspension of mucin," applied twice daily to teeth D, was freshly prepared for each treatment, as follows: About 50 mg. of dry, pulverized, pure mucin (isolated by us from ox salivary glands by the usual process) was transferred to a small porcelain crucible, and there treated with about 2 c. c. of tap water. The hydrophilic mucin rapidly swells under such conditions forming a solid mass in a few minutes. A little more water was then added—sufficient to make "a thick paste"—and the suspension applied to each crown with a rod tipped with rubber. The rubber prevented injury to the enamel and facilitated close application of the mucin paste to all parts of each crown.

The "carbon dioxid water," obtained in siphon bottles for the sake of convenience, was purchased from the Hygeia Distilled Water Company. The bottles were labeled "Hygeia carbonic." The water was free from acid and salin impurities.

Dental examinations: *Report by Dr. Arthur H. Merritt.*

The treated teeth were received by me for inspection on April 18, June 29, and October 29, 1914.

First phase. On April 18, 1914, there was sent to me for examination, three groups of teeth all embedded in paraffin, except the crowns. All were free from caries and none had ever been filled. There were 2 molars, 8 bicuspids, 8 canines, 12 incisors—30 in all, known as groups C, D, and E.

Group C contained ten teeth, as did each of the other groups. All showed more or less abrasion on occlusal surface, exposing the dentin in each instance, though the exposure in No. 3 was slight.

Group D, Nos. 10 to 20; all showed exposure of dentin on the occlusal surface, except No. 19.

Group E, Nos. 20 to 30; all again showed marked occlusal abrasion, except Nos. 24 and 30.

All three groups were rather more deeply embedded in the paraffin than were the groups examined on January 30. (See fourth experiment.) Nos. 11, 15, 16, 17, 18, 24, and 29 were stained as with tobacco smoke and several of these showed some salivary tartar. In every other respect, the whole group of thirty were apparently normal. These were all examined with the same care as were those of January 30. (See fourth experiment.)

On June 29, 1914, these teeth (groups C, D, and E) were again submitted to me. I was unable to see that any change whatever had taken place, though each individual tooth was critically examined under a magnifying glass. The enamel of the teeth was of good luster, and the wax in which they were embedded gave evidence of most vigorous brushing.

Second phase. On October 29, 1914, I again examined all these teeth (C, D, and E). They were unchanged. I was unable to note that there had been any decrease in the tobacco stains or tartar on the teeth of any of these groups.

COMMENT: *By Dr. Gies, on Dr. Merritt's report.* I saw nothing at any time during the treatment that could be added to Dr. Merritt's report. I ought to state, however, that the mucin applied to set D was mucin *at its highest degree of acidity*—higher than that of acid mucinates in saliva. The method of application insured close, intimate, and prolonged contact between

parent, since its original appearance in 1900, and it rapidly widened, for in 1902 the number of references to conditions of the mouth and teeth to oral sepsis, to anemia in connection therewith, and to their importance in relation to medical health, was thirteen in number. In 1903 the number of references, mostly under the above titles, was fifteen, including such titles as 'Dental Asepsis of General Diseases.'

"But the number of these did not in any degree represent the change of opinion that had occurred in the profession with regard to the importance of oral sepsis. For the torrent of waters pouring down along the gorge recognized as 'oral sepsis and its effects' had enormously increased, and has continued steadily to increase in volume and in force ever since. The literature of 'oral sepsis' during the past ten years and its importance in relation to almost every class of disease, is one of the largest devoted to any one condition and to any cause of disease in medicine. It has engaged the interest of specialists in almost every branch to which I originally drew attention: anemias and blood diseases; fevers and purpuric diseases of obscure origin; rheumatic diseases; children's diseases; skin diseases; ear diseases; and, lastly, perhaps the most striking of all, in relation to a great number of eye diseases.

"The general change which has come over medicine with regard to this subject of oral sepsis is perhaps best known in the Address on Medicine at the meeting of the British Medical Association in London in 1910, by Dr. J. Mitchell Bruce. His subject was 'Recent Progress in Medical Science,' and its chief theme was its 'recent advances.'

"'If I were to recount to you our gains during the fifteen years that have elapsed since we last met in London, we should indeed find cause for satisfaction. . . . I will content myself with a very brief record of the additions to our knowledge of disease, and of the improvement in our methods of diagnosis and treatment of the first magnitude only. . . . The great events to which my record of the period will be limited include the discovery of the spirochæte of syphilis; the part played by the mosquito in malaria and in yellow fever, and by the goat in the diffusion of Malta fever; the connection of a trypanosome in sleeping sickness, of the Leishmann-Donovan body with Kala-azar and of the diplococcus with cerebro-spinal fever.'

"The effects of oral sepsis have been worked out, and prove to be so widespread, so multiple, and frequently so grave as to make us ashamed of our previous blindness, to a common source of blood infection, staring us in the face all these years.'

"Such are the outstanding historical relations between the subjects of anemia and oral sepsis which have connected these two subjects in the past, and which even if they stood alone would always serve to connect them with each other in the future. That relationship is that, above and beyond any other condition of disease or any other class of studies, it was the close pathological study of severe anemia in spheres of interest

microbic life flourishes most extensively, and it has been proved to be the cause of tropical dysentery.[7] Ipecac, from which emetin is prepared, and emetin itself being employed as a curative agent.

The Endamœba, most commonly considered the cause of this complaint, is called the Endamœba histolytica. Another inhabitant of the intestinal tract, but put down as harmless, is called the Endamœba coli, and a third, an inhabitant of the mouth, is called the Endamœba buccalis, also considered harmless. These are the well-known amœbæ mentioned and described in every authentic work upon the topic. The description given of the Endamœba, which has been announced as the cause of pyorrhea, corresponds so closely with the familiar Endamœba buccalis, that morphology and life cycle considered, it hardly leaves any grounds for believing that some fine distinction exists, which has escaped the observation of such skilled and experienced workers in this field, as Craig and Simon Flexner, to say nothing of others. The work of these men represents that of a corps of able assistants, every facility for the work, and includes the examination of many thousand cases extending over a period of years.

Prof. Chiavaro, of Rome, with whom I had the pleasure of conferring upon this topic at the last meeting of the European Dental Society at Paris, exhibited and lectured upon this Endamœba, which he had isolated from Pyorrhea. He terms it properly the Endamœba buccalis, and states it is harmless, which accords with the authorities that I have mentioned. The advancers of the opinion that the Endamœba buccalis is parasitic stand alone in their opinion, so far as I have been able to ascertain, and they produce no evidence to substantiate their claim, unless they account the "cures by emetin" a proof. In the intestinal tract emetin is given not only to destroy the Amœba, but to cause the bowel to expel it. So that it will be necessary for us to know more about this Endamœba before we can accept the idea that it is parasitic, and it must be substantiated by unquestionable evidence. It is easy to produce dysentery in animals by inserting Endamœbæ histolytica. Can pyorrhea alveolaris

[7] Allbutt and Rolliston, "Tropical Diseases (Animal Parasites)."

schools of Montreal on " Mouth Cleanliness." Wealthy men in many cities are voluntarily offering to defray the expense of looking after the mouths and teeth of the poor people of the community, and for all these " signs of the times " we thank God and take courage.

It has always been a matter of very great surprise to me that, notwithstanding the great awakening with regard to the importance of "mouth conditions," no serious attempt has been made by the medical faculties to give to medical students the teaching which they undoubtedly should receive on the relation of mouth conditions to so-called systemic diseases. It is true that in some medical schools a qualified dental surgeon gives instruction to men of the final year, but such cases are the exception and not the rule. As I see the matter, medical faculties that do not give to the students such instruction are guilty of criminal negligence.

Nurses, too, should be taught the value of a clean mouth (their own mouths as well as the mouths of patients), and the best methods of bringing about and maintaining mouth cleanliness. In many hospitals this instruction, by a qualified dental surgeon, has for years been a part of the course in nursing, in many others it is still noticeably lacking. In many children's hospitals and in orthopedic hospitals a dental department, with a dental surgeon in regular attendance, is a recognized part of the equipment. Once established the value of such a department is soon recognized.

Dental clinics are now being established in many public schools, and this it seems to me is the proper place to begin, and to carry on, such work. Dental caries among school children is almost universal. If the care of the teeth were made a part of the school work, done in the school building, the dread of dental operations would disappear, and the importance of mouth hygiene would be emphasized at a time when lasting impressions are made and when serious conditions may be averted by early and easy treatment.

Many manufacturing establishments are recognizing the commercial advantages of good mouth conditions, and dental inspection and dental treatment is now a very important feature

of many of the most up-to-date manufacturing plants of North America.

In Toronto, some time ago, Dr. Kirk, of Philadelphia, gave an address to the Odontological Club, dealing with the relation of dietetics to dental caries. No thoughtful dentist now has any doubt that there is a very close relation between " the diet " and the condition of the teeth and jaws. This opens up a new field in dentistry, and it is sincerely to be hoped that the men of the profession will rise to the occasion. Dr. J. Leon Williams has done a great work in slaying the " temperamental lion." The susceptibility to decay due to the various " simple," " compound," and " complex temperaments," has been so thoroughly exploded that all humanity is under tribute to Dr. Williams, dentists most of all. Dr. Pickerill has also made a most valuable contribution to the knowledge of the relation between diet and mouth conditions. The book is not only sound in its reasoning and teaching, but the matter is presented in a most readable form as well.

The relations between mouth conditions and crime has been pointed out by many observers in sociological work. Defective teeth, in conjunction with defective eyesight and defective hearing, producing as they do abnormal conditions, affect the moral as well as the physical condition. The whole problem has a tremendous national significance.

Those of us who are associated with hospital work see every day, in the maternity wards, the disastrous results of " oral sepsis." Children are born of mothers whose mouths are reeking with filth. The result is seen in thousands of instances: the child when born gives every evidence of being poorly nourished; the mother is unable to nurse her baby and artificial feeding must be resorted to, and in many cases the physician is unable to account for the condition. But a look into the mouth would reveal the fact that both mother and child were being slowly poisoned by a continuous flow of pus exuding from inflamed gums and decayed and broken down teeth. The mother cannot maintain her own nourishment much less can she nourish her child, either before or after birth. We ask ourselves, again and again, How long? The dentists of this North American Continent have before them a herculean task of education. The *few* cannot do it, will all share in the burden?

PRESIDENT'S ADDRESS[1]

MASSACHUSETTS DENTAL SOCIETY.

BY AURELIUS F. WHEELER, D.D.S., WORCESTER, MASS.

Members of the Massachusetts Dental Society, Ladies and Gentlemen:

According to the constitution of this society your president is at this time supposed to give you a concise statement of the condition of this, and the district societies, together with such suggestions for improvement as he may deem proper.

Your president last year in his annual address recommended that the in-coming president or his substitute be authorized to make at least one official visit to each of the district societies. Believing this work to be an important one it was begun early; one district being visited at its " Fall-outing " meeting.

First, the secretaries of the district societies were asked by the secretary of the State Society to furnish your president with a list of the dates and places of their meetings. Three of the districts responded, two did not, but as the assistant secretary has had occasion to be present at meetings of those two districts, he will have to be allowed to qualify as your president's substitute, and call his presence at those meetings the official visit to those districts.

All the districts seem to be enjoying a healthy and vigorous growth, each one doing its work well and according to its own requirements. The fifty cents per capita rebate granted last year to the districts outside the metropolitan district seems to have encouraged them to better work, and the executive committees of the various districts are to be commended for the efficiency of their work in arranging programmes and in procuring the attendance which they have. They might, however, with very little extra effort furnish similar enthusiasm and encouragement to the members from their respective districts to attend the annual meeting of the State Society. Also, the councillors from the districts should realize that they are a connecting link, as it were between the district and the State societies.

[1]Read before the 50th Anniversary Meeting of the Mass. Dental Society, Boston, May 7, 8, 9, 1914.

They really have a work to do, and should be in attendance at the call to order, and remain in attendance until the adjournment of the councillors' meeting, and they should be held responsible by their district societies for this work, forfeiting their office for neglecting to fulfill these conditions without good and sufficient reasons.

It has been rather startling to me in visiting the different districts to find so many men uninformed and entirely astray in their ideas of the work as it is carried on by the State Society, many seeming not to sense the fact that each individual member is responsible for his efficiency as part of the society, and that the influence of his membership in the society will be, much or little, good or bad, according as he conducts himself. Some even seem to think of the State Society as a little nucleus of dentists from an indefinite place somewhere, whose sole business it is to furnish each member everything that he is unable to obtain for himself.

Your president has heard a few criticisms regarding the personnel of the various committees, that too many of the same men were serving year after year, and that new and younger blood should be infused into the committees. In taking up the work at the beginning of the year, your president found that, according to the constitution, he had certain committees to appoint for the various lines of work mapped out by the society. These committees required the appointing of a hundred or more men. The filling of these committees called for men who knew what work needed doing, men who knew how to do the work, men who had the time, or were willing to sacrifice their time for the sake of the society, the profession at large and the welfare of the general public. The needs of the committees called for men from all parts of the State, in order that each district should be properly represented in the work of the society. This work would be easy of accomplishment, if one could appoint from his own acquaintances in his own district, but to apportion them out to the different districts is quite another matter. In my own district no man is serving on more than one committee, the other extreme is where one man is serving on five committees; but, gentlemen, that man is doing the work of five men, and is deserv-

ing of the credit due five men. In thinking of men from districts other than your own, you naturally look for, and think of, faces which you have been accustomed to see in attendance at the State meetings, with the result that where the attendance from any district is limited to a few and to the same ones year after year, you naturally must expect to find those same few on the committees year after year.

Within sixty days from the annual meeting the committees were filled, and the various members had received from the secretary of the State Society a notice of their appointment.

Believing that no one is entitled to the full privileges of active membership unless he is willing to do his full share as an active member, none were asked to serve; they simply were appointed, and with the exception of consulting with chosen chairmen in regard to whom they would like to have serve on their committees, no one was consulted; therefore, if any blame is to be placed, it must be on your president, and on him alone.

How well the members of the society responded to their appointments is shown by the fact that but two refused to serve, and later one other resigned; but so well in hand was the work of his committee at that time, that he received no notice of the acceptance of his resignation, and no one was appointed in his place.

Some committees were handicapped at the beginning by being notified that there were no funds at their disposal with which to carry on their work; but in proportion as your committees have been permitted to do their work they have responded with excellent service, and I wish at this time officially, and personally, to thank them all, especially the Committee on Dental Education, the Law Committee, the Committee on Dental Legislation; also the various committees in charge of this meeting are deserving of commendation; and last but not least, your president wishes to thank the Executive Committee, on whose shoulders has rested the welfare of this society for the past year. The Dental Hygiene Council, while its members from this society form only an integral part of that council, and the council in its entirety is not a component part of this society, are doing a great work and are worthy of great praise.

Your president believes that a different method of finance should be worked out for use by this society, in so far as to provide that each committee requiring the use of the society's money should have a certain appropriation from which to draw, and on no conditions to overdraw that appropriation, but that the Executive Committee have the power to increase an appropriation, when called for by a committee, if in their judgment it seems best to do so.

The matter of membership is vital to the society, and your president would recommend that a committee be appointed carefully to redistrict some parts of the State. For instance, the central district covers all of Worcester County, and its membership is almost entirely limited to the city of Worcester, for the reason that it is impossible to get from the cities and towns in the northern part of the county to Worcester to attend the meeting and then to return the same night. Other towns could, a great deal more conveniently, meet in other districts, should certain other districts be formed. And by forming some new districts and rearranging some of the present ones, the membership of this society could be increased fifty per cent. or more.

Another recommendation which I would make is that the office of assistant secretary be made appointive instead of elective. The work of that office should be designated as that usually performed by a corresponding secretary, and the secretary's work be designated as that usually performed by the recording secretary, and the funds now in use for clerical work and typewriting be subject to the use of the corresponding or assistant secretary. This would greatly facilitate the work of the society so far as the correspondence is concerned, and now that the various State societies have become affiliated with the National Dental Society this correspondence will be greatly increased and demands increased facilities over those now in use.

That this is the fiftieth anniversary of the society you are doubtless aware, but as one of the younger members, your president feels it would not be fitting for him to summarize the work of the society through the years past, but rather leave that to a later session and to those who have kept pace with the society during its years of existence and have taken part in its struggles and triumphs.

CHEMISTRY OF OXYPHOSPHATES[1]

By W. S. Medell, B.S.

Late Instructor in Chemistry at the Colorado School of Mines.

The purpose here is not to go into the deep seated and highly technical reactions involved in the chemistry of oxyphosphates, but rather to deal with the practical side of the question and give such information as will help in determining the value of oxyphosphates other than the special class of transluscent oxyphosphates commonly known as silicates, artificial enamel, synthetic porcelain, etc.

Dental cements commonly known as oxyphosphates are all, at best, slightly soluble, and on that account do not come up to the ideal for filling purposes. This solubility is very pronounced in some cases and in others practically nil. It is not at all certain that it is impossible for a technique to be developed insuring a result which will last for several years in all cases. The points in favor of these fillings are nonconductivity and the perfect margins maintained to the last. In practically all cases it is found that the cement wears out in cup form, so that protection to tooth structure is perfect even though more than seventy-five per cent. of the filling material has been washed away. For inlay, crown and bridge work the best type of cements are all that can be desired, if they are properly handled.

The value of the powder is determined by its composition, density or specific gravity, and fineness. Powders contain, in addition to zinc oxid, magnesia, silica, alumina, or copper oxid, in either red or black form, for cementation purposes; bismuth oxid and sometimes other compounds for medicinal purposes; carbon, manganese oxid, chromium oxid and compounds, iron oxid and various other substances as pigments; and arsenic and sometimes cadmium oxid as injurious impurities. Magnesia is of distinct benefit, giving high adhesive qualities. Silica lends wearing qualities in added hardness. This advantage is overbalanced by the slow neutralization or prolonged acidity induced. This prolonged acidity is responsible for the chance of irritation and solubility.

[1] Read before the Massachusetts Dental Society, Boston, May 7, 8, 9, 1914.

There is greater liability of dead pulps under cements containing silica than from almost any other cause. Arsenic is always objectionable. The claim that any arsenic present is combined with zinc oxid to form inert zinc arsenite means nothing when it is known that this compound is broken down and arsenious oxid liberated by the action of the cement liquid.

Density of powder is produced by calcination, the higher the temperature the greater the density. The most modern methods make use of a temperature as high as 3,600 degrees F., the powder produced being of a brilliant whiteness. Heretofore the light shades of powder, not even white at that, but cream color, have been produced by calcining at such a low temperature that the integrity of the product was much below what it should be. On the other hand the powder given a higher heat was of such a bright yellow shade as to be objectionable and was darkened by the addition of iron oxid so that the manufacturer claimed and the dentist realized that the darker shades were best. Now, however, all shades from white to dark gray brown should be of equal grade, and be produced by the addition of the necessary insoluble pigment to cement powder calcined at the highest temperature. In no case should such an amount or kind of pigment be used as would injure the quality of the product. Fineness plays a great part in the final result and in the working qualities. From a mechanical standpoint the finer the powder the better.

Cement liquid of the older type was composed of a solution of glacial or metaphosphoric acid in water. When this acid is pure and as long as no change takes place, such a liquid is very satisfactory. Unfortunately, solutions of metaphosphoric acid change to orthophosphoric acid and trouble ensues. Great heat is liberated and the mix sets so quickly, that, as the Irishman might say, it does not set at all. In other words the crystals are formed as individuals and do not intermesh, a powdery condition resulting. Orthophosphoric acid has three active or acid hydrogen atoms, each one of which possesses a different degree of activity. That of the first is very pronounced and a large amount of heat is given off when it is replaced by a base as zinc. The second is much quieter, while the third is so faintly acid in nature that tribasic phosphates exist in the solid condition only. Even such a

powerful base as sodium does not retain its place in solution. When tri-sodic-phosphate is dissolved in water the solution gives an alkaline reaction. This proves that the compound has been broken down and di-sodic-hydric-phosphate formed, the other atom of sodium forming sodium hydrate, the presence of which is responsible for the alkaline reaction of the solution. As this acid is the only practical acid of phosphorus it becomes necessary to modify it in such a way as to control its reaction. This was first accomplished by partially neutralizing with sodium, potassium or ammonium. Because all of these produced soluble compounds recourse was had to the use of aluminum. This being a non-alkaline base, and the final result in the completed mix being insoluble, it proved to be the perfect modifier, and there is hardly a cement liquid on the market to-day in which aluminum is not used for this purpose. Perfect liquid should be clear and remain so.

It is not possible to have more than one liquid meet the conditions imposed by a properly made powder. In general, quick setting liquids are made so by the addition of an excess of water. This excess will not unite and its subsequent loss will cause either contraction or porosity. Slow setting liquids are thick and concentrated and they do not carry enough water to allow the proper reaction to take place. The result is that not only is slow setting produced, but slow ageing or neutralizing as well. The evils of prolonged acidity are present to nearly if not quite as great an extent as in a cement whose powder carries silica. More chemical reactions depend on the presence of water in proper amount than on that of any other one reagent. For example, perfectly dry hydrochloric acid gas will not turn blue litmus paper red; perfectly dry ammonia gas will not turn red litmus paper blue, water must be present before these powerful reagents will yield such characteristic reactions.

To obtain slow setting proceed in the following manner: To two or three drops of liquid add a quantity of powder, no larger than a pin head; spatulate to uniformity and allow to remain on the slab for at least two minutes. A longer time than this will do no harm, but at least two minutes must be allowed for solution to take place. The mix is completed by adding rather

small amounts of powder, thoroughly spatulating each one, until such a consistency is reached as will allow it to flow very sluggishly on the blade of the spatula, and not drip. The quick setting mix is made by starting with a much larger amount of powder, quickly and thoroughly spatulating, and without waiting adding the next and similar amount of power, and so on until the same consistency of mix is reached as in the slow setting method. Thorough spatulation is reached when the liquid and powder are mixed to a uniform consistency.

In case the powder is of proper fineness the mix will be smooth like cream, and flow under the spatula without leaving streaks on the slab. In case streaks do appear they indicate the presence of coarse particles. It may be mentioned here that the chemist tests the fineness of a powder by placing some between the teeth; any coarse particles will be detected at once. The chemical reaction under consideration will take place within a wide range of proportions of powder and liquid. Exact atomical construction is not demanded, as, for instance, in the formation of water from hydrogen and oxygen. Nevertheless, experiment shows there is a point at which the best results are obtained, which is at the stiffness of mix given above. The mix should fully neutralize in not more than forty-eight hours, and not less than twenty-four. Acidity prolonged beyond the first will continue indefinitely, and less than the second period will lead to improper crystallization and consequent lack of integrity. It seems almost silly to say that powders should be free from carbonates, and were it not for the fact that one of the most prominent cements on the market has this fault it would not be mentioned here. This impurity leads to porosity and causes an exactly similar action to the generation of carbon dioxide in a biscuit by the baking powder added for leavening purposes. The mix " raises " and inlays or crowns are liable to be forced out of fit, or if held in place the pressure of the imprisoned gas is liable to cause trouble. It is detected by effervescence taking place when powder and liquid are brought together.

There is one most important property which dental cements for any purpose should have; that is impenetrability. So very few are perfect in this respect that the profession has cause to

think it impossible to avoid the presence of the very pronounced odor which is found under crowns. This odor will not be present unless saliva has penetrated the cement mass. To test a cement for penetrability, take a properly made mix, allow it to set until it is so stiff it will nearly resist indentation with the finger nail, then drop it into red ink and allow it to remain ten days. When broken open, the ink should not show except to stain the very outside surface. Such a cement will remain sweet under a crown indefinitely.

Proper adhesive qualities are only shown by actual application, not by the action on the slab in the open air. In fact, when a cement adheres to a glass slab in the air, it is a very good indication that it has the fault of prolonged acidity.

Hydraulic properties should be pronounced. Confusion as to what is meant by this has been brought about by the claim that a cement is hydraulic when it sets quickly on being immersed in water. The water in dental practice being saliva, this means that the cement absorbs saliva, something which should not happen under any condition. The true meaning of the term hydraulic, as applied to dental cement, is that the cement ages better and properly under water, because the surrounding moisture prevents the loss of the water in the cement, and holds it there until it is united and becomes part of the chemical structure as water of crystallization.

Copper cements merit a paper of their own, but on account of the large amount of discussion of the subject at the present time it will not be out of place to say something here. An oxysalt is a chemical compound in which the basic oxid is in excess of the amount necessary to neutralize the acid oxid. Oxyphosphate of copper is therefore a compound in which there is an excess of copper oxid over that necessary to neutralize the phosphoric oxid. Hence it is not possible to have a copper oxyphosphate without the use of copper oxid. There are but two oxids of copper, cupric, or black, and cuprous, or red; copper cement can only be one of these two colors, as no other compound of copper has cementing action with phosphoric acid. To call any cement a copper cement simply because it has some copper in it is a misnomer. Suspicion is at once aroused by this play on words. Cop-

per salts added to a zinc oxid powder with the object of calling the latter a copper cement merit suspicion, to say the least. The fact is that if enough copper salt is added to give the known effects of true copper cement, the zinc cement will be injured to such an extent as to be worthless. There is no object, from the dental viewpoint, of having a red cement. Hence, when a cement is colored red and a small amount of copper salt added and the compound sold as red copper, the intention is to deceive. This is being done because red oxid of copper has been shown to have decided advantages over the black. To detect this imposition is very easy. Burn some of the suspected powder with a match; if it is wholly or in large part composed of cuprous oxid it will be converted to the black, and prove itself. Better still, spatulate a small amount of the powder with the liquid which comes with it. The mix should turn very much darker than the original powder, bacause one part of the copper present is changed to the metallic state. On the other hand, if the mix stays red and does not turn very noticeably darker, the cement does not owe its color to the presence of red oxid of copper.

REPORTS OF SOCIETY MEETINGS

FIRST DISTRICT DENTAL SOCIETY OF THE STATE OF NEW YORK

October 5, 1914.

A regular meeting of the First District Dental Society, State of New York, was held at the Academy of Medicine, 17 West Forty-third Street, New York City, on Monday evening, October 5, 1914.

The President, Dr. S. E. Davenport, occupied the chair and called the meeting to order.

Dr. Frank A. Delabarre, of Boston, read the paper of the evening, which was entitled " A Study of the Physical Development of the Occlusal Curve."[1]

Discussion on Dr. Delabarre's Paper.

Dr. George C. Ainsworth, Boston—Mr. President and fellow Members: Before proceeding with a discussion of the subject of the evening, I desire to embrace this opportunity to thank you most heartily for the honor you have done me in electing me to honorary membership in this society. If my contributions to the science of orthodontia have been a help to any of you, I am very much pleased.

We have witnessed a remarkable demonstration of theories to-night which may well nigh approach facts, made possible by this model, the conception and construction of which evidences a man of great ingenuity and tenacity of purpose, a courage and continuity of aim that few of us possess, and stamps Dr. Delabarre with unusual ability as an orthodontist. I am proud to be thus associated with him to-night.

No one can have listened to the paper of the evening without being impressed with the fact that the author has thought deeply on the subject and that he throws a searchlight on an avenue that has received little attention as yet; one in which the orthodontist

[1] See Dr. Delabarre's paper in full at page 546 of the present issue of THE JOURNAL.

is primarily interested, since a perfect occlusal curve cannot be developed unless the teeth are all in perfect occlusal relation, such as can rarely be established unless at the time of their eruption (naturally or otherwise).

So far as I understand him, Dr. Dalabarre's deductions seem reasonable and correct, and the object of the occlusal curve (which, by the way, I would designate as being compound in its nature, since it not only curves mesio-distally but also forms a segment of a curve across the mouth, and besides, curves buccally from the mesial line to the third molar) is to permit of the more perfect efficiency of the masticatory machine.

I would draw your attention to the fact that these curves are not particularly noticeable until the development of the second and third permanent molars, and also that they take on and help to preserve the natural curvature of the maxillary bones and are of inestimable importance in the development and preservation of a beautiful and harmonious contour of face.

The development of the occlusal curve is dependent upon the preservation of the temporary teeth, to the end that an orderly eruption of the permanent teeth may prevail and a maximum efficiency of the permanent teeth be established.

It is interesting, and I would emphasize what Dr. Delabarre has said regarding the order of the eruption of the permanent teeth. You will notice that, as a rule, the lower teeth precede the upper by some months, up to the replacement of the temporary molars by the bicuspids, when the order is reversed and the upper first temporary molars are the first ones to give way; followed by the lower first temporary molars, then the upper second temporary molars, and lastly the lower second temporary molars.

The object of this change in the order of eruption would seem to be to allow the upper bicuspids to develop a little longer than the lower, and thus establish the low line or point in the occlusal curve. Now, any deviation from this natural order of eruption must almost positively affect the curved turn of occlusion, hence the great importance of attention to the temporary teeth in case of caries, for just as sure as we have a dead pulp in a temporary tooth, and consequent lack of absorption of the roots, we have an interference with the development of the oc-

clusal curves. This applies more particularly, perhaps, to the temporary molars, since they are the only teeth to spread their roots over the crowns of their successors and so, positively and effectually, govern their development and eruption. How important, too, is the preservation of a healthy pulp in these temporary molars in order that the permanent biscupid crowns may not suffer. The bicuspids are the only teeth which cannot erupt without absorption or displacement of their predecessors.

I would also emphasize the point Dr. Delabarre makes in the difference in the space occupied by the temporary molars and the permanent bicuspids, which seemingly allows the first permanent lower molar to tip slightly forward at the time of the eruption of the second lower bicuspid and thus take its place in the formation of the curve.

The efficiency of any machine depends upon its perfect construction, and while there are many machines that absolutely refuse to perform their functions unless they are perfectly adjusted, the dental machine seems to be an exception, since the perfectly constructed and adjusted set of teeth is the rare exception rather than the rule—in fact, it is so rare as to excite little notice or appreciation from the average practitioner.

Finally, the deductions from the paper and from a continuous practice of orthodontia of nearly forty years—in which I have been particularly interested—in connection with a general practice of dentistry, absolutely convince me that orthodontic service must be rendered early and in the formative period in order to obtain the most satisfactory results. It is only when our work and interest leads us into a deeper study of our subject that we come to realize and appreciate the exquisite beauty and wonders of nature, the infinite wisdom and loveliness of the divine architect, the author of all our being.

(*Referring to Photographs*)—I have here for your observation some photographs of a set of models which I have in my collection, representing one of the most perfect sets of teeth it has ever been my pleasure to see, not only individually but collectively, and showing most beautifully all the curves and natural relations, which Dr. Delabarre has so well described and illustrated with his mechanical model. You will observe that there are thirty-two teeth present and every one is in perfect normal

occlusion, so that when the models are placed together and held up to the light you can scarcely see through between the occlusion at any point. The conditions are really more beautiful than the photographs show them. Such a condition can obtain only when the eruption has been natural and in order, and it excites a pleasure and admiration at the wonders of nature. Every curve and line is wonderfully perfect and beautiful.

Dr. Edward A. Bogue—In his description of the occlusal curve, Dr. Delabarre is right in describing a normal case; and he finishes the description with the adult row of normal teeth.

We see but few such cases in American cities.

Prof. J. Choquet, of Paris, discussing this occlusal curve before the American Dental Society of Europe this summer, says that the curve is a real one, and is produced by the more or less early (or late) eruption of the first *lower* molar, which acts in that case as an efficient cause in the building of this more or less sinuous line.

Professor Choquet also says that the deeper is the occlusal line or curve, the more convergent are the axes of all the teeth towards an ideal point which is, in that case, the top of the frontal bone. He says that the expression, "compensating curve," is wrong, for it does not compensate anything.

Dr. George H. Wilson, of the Western Reserve University, Cleveland, says that the term "compensating curve" should not be used as being synonymous with the "curve of Spee," for the curve of Spee belongs entirely to the mandible, and is anatomical, while the compensating curve is mechanical, and should always be established in complete *artificial* dentures. "The compensating curve is that arrangement of the teeth whereby the so-called three-point contact is established between the upper and lower artificial dentures."

An article read before the New York Odontological Society in May, 1889, recites that at nine years of age "the temporary molars are all still in their places. The permanent molars below have (at that age) risen just enough above the level of the temporary molars to make visible the beginning of the upward and backward curve of the molar teeth of the lower jaw. This curve has a most important bearing upon the arrangement of the teeth, their retention in proper position, and the length of the bite."

I think this curve is best seen from the tip end of the fully erupted lower cuspid to the posterior buccal cusp of the lower wisdom tooth, while the convex curve can be seen on the upper row of teeth from cuspid to wisdom tooth.

Among the factors that determine the degree of curvature, Dr. Delabarre enumerates the distance between the condyles, which Dr. Cryer shows us in his internal anatomy of the face is from 3⅜ to $4^4/_8$ inches, "and the depth of the fossa, which becomes deeper with adult life, depending on mobility and on occlusion."

All rodents, like the badger and rat, have deep fossae and locked teeth, while ruminants, like the cow and the deer, have very little depth of fossae.

It is fair to believe that children who begin to masticate as soon as they are weaned will thereby assist in the proper development of the fossae and the eminentia articularis.

Dr. Delabarre thinks that it is seldom that any mal-occlusion of the temporary teeth presents itself at the age of three.

I believe this is quite true, but the mal-occlusion exists all the same if it does not present itself, and would be quite perceptible at four or five years of age to the skilled observer.

The differences in the periods of growth of the child are, as Dr. Delabarre observes, quite distinctly marked, and we should study them carefully. He says that growth in the incisor region begins to be evidenced about the age of four to five by the gradual separation of the temporary incisors, etc. May I suggest that Dr. Delabarre should insert "if normal growth be present"? If there be an arrest of development the temporary teeth will probably remain close together and the permanent teeth will come through the gums irregularly—just as they lie in their crypts.

If normal growth be not present, it is because the action of the heart and arterial system is weak, and proper steps should be taken to correct faulty conditions.

Dr. Delabarre says that "the cuspids are the keystones of the arch curve," etc. He does not say keystones of the occlusal curve, for the first permanent molars occupy that position, I believe.

I think we are indebted to Dr. Delabarre for a very clear and instructive diagrammatic drawing of the conditions that

should prevail in the incisor region from six to nine years of age and one that illustrates the manner in which the parts are stimulated to increase in width.

When he comes to describe the way in which the bicuspids, lying within the grasp of the roots of the temporary molars, are guided in such way that their direction is forward toward the anterior teeth, because the bifurcation of the lower and the trifurcation of the upper molars is mesial to the center of those teeth; and the inclination of the distal root is greater than that of the mesial, he shows an accuracy of observation that should encourage us all to carefully follow him in his deductions, and to emulate him in our work.

When he says that the pressure of oncoming bicuspids causes a rapid and pronounced "elongation" of these loosened temporary molars, he means, of course, a rising above the original level of these teeth. I have often noticed this phenomenon, but never before attributed to it the influence that Dr. Delabarre shows us, in the matter of opening the bite just at this time, when it is distinctly required.

The rest of his description of the mechanism of eruption is admirable and merits careful study, and shows how a little guidance at exactly the proper time will often give a regular denture to a person who without that guidance would erupt an ugly and inefficient dental apparatus.

Dr. Delabarre's deduction from the hypothesis that the size, shape and angle of the eminentia articularis is governed by the repeated excursions of the condyle during the functioning of the mandible, is undoubtedly correct, namely, that no case of malocclusion that has passed the age for growth in this region with teeth in mal-position, can have developed a normal eminentia or have a normal condyle path, and no such case can ever be made normal, by attempting to change one of the factors alone. *i. e.*, the position of the teeth.

Dr. Frederick C. Kemple—Before attempting to discuss the paper of the evening, I wish to compliment the essayist on the wonderfully ingenious model which he has used to demonstrate the normal development of the denture and to emphasize the points brought out in his paper. The conception and construc-

tion of such a mechanism attests concentrated and careful observation as well as unusual skill in mechanical achievement.

When I was invited to take part in this discussion I received the impression that the essayist would probably discourse on the subject of malocclusion and the question of early treatment, and I rather regret that he has not done so to a greater extent, for I must frankly admit that I have given but little thought or study to the development of the occlusal curve. I have never considered this curve to be of any particular importance as a factor in producing either normal or abnormal occlusion of the teeth, but have always regarded it entirely as an " effect " or " result " of the relation and arrangement of the upper and lower teeth, and, in itself, not in any way a *cause* of anything. It is a sort of a will-o'-the-wisp in form that changes its shape in accordance with any arrangement of position which the teeth may assume. The condyle path varies in the same manner, *i. e.*, they both adapt themselves to any variation in the denture.

If the teeth erupt in malposition, the individual, by shifting the mandible, will find the most comfortable way of closing his teeth and use it, and through *use* this particular relation of the teeth becomes the established or fixed occlusion; and through the establishment and use of this " most comfortable occlusion," the condyle finds its seat in the glenoid fossa, and the path of the condyle is shaped accordingly. Thus, in my opinion, both the antero-posterior and lateral occlusal curves, and the condyle paths adjust themselves to any arrangement in which the teeth may erupt; and if at any time there is a change in the arrangement of the occlusion of the teeth, there is also a corresponding readjustment of the occlusal curves and of the condyle paths.

The occlusal curve found in practically all cases of malocclusion belonging to Class II, Division I (Angle classification), is usually much more marked than the curve of the normal denture. In the successful treatment of these cases the overbite in the incisor region is changed, the molars and bicuspids erupt to a greater height, and the occlusal curve becomes changed from the arc of a smaller to the arc of a circle which has a greater diameter. In other words, the curve is changed by changing the positions of the teeth, and it approaches the normal compensat-

ing or occlusal curve just to the degree that the teeth approach their normal positions in the arches.

I have never seen, even in the most perfect natural dentures, the ideal compensation in curves that the expert prosthodontist can produce on his anatomical articulator. The late Dr. Bonwill used to say that he could "articulate teeth better than the Creator ever did"; and from a purely mechanical viewpoint, he probably could. He could at least do it with mechanical and mathematical exactness, but nothing in nature is ever built with mathematical accuracy; and nature knows no such thing as perfect symmetry in her architecture.

In demonstrating the development of the occlusal curve the essayist has shown an orderly sequence of eruption of the teeth that occurs so seldom that we can almost say it never happens; this accurate chronology of the transition from the deciduous to the permanent denture is, perhaps, as it *ought to be,* but *never is.* It is so rarely that any of us have the pleasure of seeing the ideal eruption of the teeth, that I would be inclined to question the accuracy of the table used by the essayist, and compiled by James & Pitt, of London, in which they estimate over 50 per cent. of the dentures to erupt in this orderly manner. They certainly do not do so in such large proportion here in America, and if the so-called civilized races continue to live on a diet that is ingested without mastication, the orderly development of the denture, so beautifully outlined by the essayist, will become more and more only a record of the past.

I was pleased with the essayist's method of dividing the denture into separate zones as a better means of observing the periods of growth in these regions. It simplifies the difficulties of observation and enables one to be more accurate in recording measurements of the growth in these parts. If he could now find some approximate standard of size for the arch at the different ages of the child it would be a real boon to the orthodontists. These periods of growth vary so greatly in different children that we are seldom able to say definitely what is the normal amount of development for the particular child under examination. What may be a perfectly normal development for one child at six years of age may be far from normal for some other child at the same age. It is for this reason that I am opposed to im-

mediate orthodontic treatment in these young children at the first symptom of possible malocclusion; and I regard it as absurd and cruel treatment to expand these baby arches to the extent they should be for the adult.

I agree entirely with the essayist that insufficient lateral growth in the region of the upper temporary cuspids is the frequent direct cause of Class II malocclusion, and many of these cases can be corrected easily by early slight expansion in this region. Also in other instances, where any other region happens to be *extremely* under-developed, it is rational treatment to stimulate the growth of the part at about the time this growth should take place naturally; but in my opinion the early treatment should stop at that, and not be carried on to include the entire denture. Nature should be given ample opportunity to do her part in development, and if she fails, it is not too late when the child is nine or ten years of age for the orthodontist to give his aid. Also on the question of extracting temporary molars, my opinion is in accord with that of the essayist—as a rule they should not be extracted until they are ready to drop out of themselves. But frequently these teeth are firmly supported in place by adjoining teeth long after their roots are entirely absorbed—they are ready to drop out but cannot because of this support, and they must be extracted. In such cases it is a wise precaution always to have radiographs made to assure yourself that the bicuspids are present, before the temporary molars are extracted.

In regard to the elongation of the loosened temporary molars being the initial step in the formation of the adult occlusal curve; and that the eruption of the upper bicuspids from six months to a year earlier than the lower fixes the low point of the curve in this region—I believe both may be factors in the formation of the curve, but neither one alone or both combined can be the fundamental or chief cause of its production. The lower bicuspids frequently erupt six months or more earlier than the upper, but this variation in the order of eruption does not alter the location of the low point of the curve.

In closing, the essayist says: " The next great step in orthodontia as a science is the complete mastery and understanding of the physical and mechanical laws that govern the development of the jaws and their function."

Tennyson wrote:

"Flower in the crannied wall,
I pluck you out of the crannies,
I hold you here, root and all, in my hand,
Little flower—but *if* I could understand
What you are, root and all, and all in all,
I should know what God and man is."

When we have completely mastered and understand all the laws of the physical and mechanical development of the jaws and their function, I believe we will come very near to knowing "what God and man is."

Dr. Delabarre (in closing discussion)—I wish to thank you as an audience for your close attention and the sympathy I have felt. It is particularly gratifying to me to have Dr. Ainsworth come here and treat me so kindly. I feel whatever I am in dentistry I owe very largely to him, inasmuch as the first five years of my experience in the profession were spent in his office, and from him I got my inspiration for the work I have done.

Dr. Bogue quotes Dr. Choquet, of Paris, and if I understand his quotation correctly, that the first permanent molars are responsible for the development of the occlusal curve, I would differ from him. I believe the bicuspids are the ones that start the development of this curve, and establish its low point, and the first permanent molars, in that second position they assume, only continue the work the bicuspids have started. I will confess my inability to recognize malocclusion as being present in most or many children at the age of three years, simply because I do not thoroughly understand what is absolutely normal at that age, and if I do not know what is normal, I cannot know what is abnormal. However, according to Dr. Bogue's figures, if 71 per cent. of the children in New York have abnormalities, I would hazard the guess that at three years 95 per cent. of the children have normal development of the maxillae, and only 5 per cent. have abnormal development.

Dr. Bogue speaks of lack of development of the temporary incisors, and says it indicates a lack of arterial sufficiency, and I agree with him, inasmuch as I believe the active cause toward the eruption of all the teeth is arterial blood pressure coupled with the normal growth of the roots of the teeth, and where the

blood pressure is not normal, eruption will be slow. The ends of the roots of the teeth, during their growth, rest on a very vascular structure, and from the blood the materials are supplied to make the increased growth of the dentin of the root. If that blood is insufficient in kind, quality, amount or amount of pressure, the growth of the root will be slow, and eruption delayed.

Take another fact which has been developed by Dr. George Wright, of Boston; children who are erupting teeth will often become feverish and fretful, refusing food, and after going without food for a while, the child becomes quieted, the fever disappears, the fretfulness vanishes, and then the eruption goes on. He says the blood pressure is forcing the tooth hard on the gum, and there is not only pressure on the gum, but back pressure on the vascular structure. Nature demands relief from the pain, and that is accomplished by the reflex loss of appetite; the tension is relieved, the child becomes free from pain and the fretfulness stops. Nature resumes the work at a slower and more normal rate. I agree with Dr. Bogue when he says the lack of growth in this region is indicative of a disturbance of the arterial system.

I am afraid Dr. Kemple has not fully understood my purpose in presenting this paper. I did not present it from the orthodontic standpoint merely, but from the general standpoint of dentists, and as coming from me as a dentist. It interests me not only from the field of orthodontia, but from general practice as well, and it bears on the whole field of dentistry.

I will freely confess my ignorance as to what constitutes normal occlusion. I do not understand it, although I try hard to, and I feel what I have discovered and presented to you tonight is merely an effort on my part to add a small iota to the total of what constitutes the normal. It may be unimportant, and it may not be true; but I believe it is true and that it is important, although it is very small when you consider the whole field of normal occlusion. If I have established the fact that at the age of ten or twelve the occlusal curve begins to develop in the bicuspid region, I feel I have increased some of our knowledge of what constitutes normal development.

I believe in early interference in cases of malocclusion, as early as the tendency towards malocclusion manifests itself, even at the age of four or five, which is about as early as you can get

hold of a child and govern it in the chair. I would not consider for a moment doing anything more than Nature would at that age—that is, providing a little increase in the breadth of the child's face. It is absolutely ridiculous to attempt to establish the curve—absolutely absurd to attempt to give to the child of six or seven the width that belongs to the adult of six feet two.

I believe in providing the amount of growth that the zone of growth and the character of growth and the age demand. Now what is that? I confess I do not know in whole. I do know in part, and I work according to my knowledge.

Dr. Kemple says normal occlusion never happens. I would agree with him that it seldom happens. Nevertheless we must understand what normal occlusion is, if possible. We must understand what Nature is trying to do in developing the child's face, else it is presumptuous for us to attempt to improve on Nature.

To me the occlusal curve comes nearer being governed by mechanical laws than the arch arrangement, or any other arrangement of the teeth. If you take this model, and set up the permanent teeth in what you consider normal occlusion, and then change one factor—for instance, the length of the ramus—the occlusal curve cannot be the same. Or change the width between the condyles, or the distance from the condyles to the incisors. The change of one factor absolutely necessitates the change in the character and size and shape and degree of curvature of that curve.

Given any set of factors of definite dimensions, and a set of teeth to set up according to those factors, you can get but one normal occlusal curve, whereas the same factors allow a wide variation of the arch curve without departing from the normal.

Dr. Chayes—I would like to know why you place so much importance on the occlusal curve, if you do not know its purpose.

Dr. Delabarre—In answering that, I would say that to save time I did not attempt to read my paper, but spoke from my outlines. I will read this sentence:

"The evident purpose of this occlusal curve is to permit the teeth to perform their separate functions of incising and masticating, without either interfering with the other."

Dr. Chayes—I would like to ask if the development of the maxillary sinus is a causative factor in depressing the first permanent upper molar, or is the depressing or lowering or tipping a causative factor in the enlargement of the maxillary sinus.

Dr. Delabarre—I do not know.

Dr. Chayes—Do you consider these pictures a fairly accurate presentation of normal occlusion?

Dr. Delabarre—I have not studied them, but would say fairly so.

Dr. Chayes—I consider those models fairly representative of normal occlusion, and I want to call your attention to the formation of the maxillary curve there. It is caused by the trussing of the inferior mandible at the point where the ramus begins to ascend. If you drop a line going back and entirely forget the third molar, there will be a fairly straight line, almost no curve at all, and the so-called tipping of the molar there is also absent. It seems to be perfectly straight.

Dr. Delabarre—It is difficult to make such an assertion without seeing the patient and the models. You cannot tell from study of models or pictures alone, because you cannot determine what the vertical position is, or the relation of other important factors.

Adjournment.

FREDERICK C. KEMPLE, D.D.S.,
Editor, First District Dental Society

FIRST DISTRICT DENTAL SOCIETY OF THE STATE OF NEW YORK

November 2, 1914.

A regular meeting of the First District Dental Society, State of New York, was held at the Academy of Medicine, 17 West Forty-third Street, New York City, on Monday evening, November 2, 1914.

The President, Dr. S. E. Davenport, occupied the chair and called the meeting to order.

The address of the evening was delivered by Prof. William J. Gies, of Columbia University, entitled: "A Further Study of the Effects of Acid Media on Natural Extracted Teeth." [1]

Discussion on Dr. Gies' Address

Prof. H. Carlton Smith—Mr. President and members of the First District Dental Society: It is always with great pleasure and profit that I accept an invitation to your meetings. I was present at the meeting several years ago when I think Dr. Gies gave his first report on his work on saliva to the Institute of Stomatology. He made one remark at that time of which I have often thought; he said he came to this work with a wholly unbiased mind, and with no opinions to prove or disprove. To-night Dr. Gies has in effect repeated the statement and I want to give my hearty commendation to the methods by which this work has been carried out. It is the only way in which to do research work, because it is so easy to become enthusiastic over our own ideas and we try so hard to prove to other people the correctness of our thought, that sometimes we neglect to consider carefully whether or not we may be deceiving ourselves and misleading others. For something over ten years we have been giving considerable attention to the problems of oral hygiene, and perhaps two reasons might be given as to why we have to-day so little positive knowledge on the subject. The first is this fact of personal bias and the second is inadequate preparation for real research work. That this last is due in part to the dental colleges I believe will not be questioned. We are not giving the

[1] See Dr. Gies' paper in full at p. 554 of this number of THE JOURNAL.

boys the sort of dental chemistry which they need in order effectively to grapple with some of their specific problems.

I feel Dr. Gies has presented this matter in such a way that there is no possible question about the result of his work. His findings are conclusive, and while it may not be wholly desirable to discuss an essay by saying " Amen and Amen," there are some things which I would like to emphasize; for instance, the protective action of the saliva against action of acid *beyond* the slight neutralizing effect due to its natural alkalinity.

A few years ago we tried an experiment to prove this fact in connection with the classification of tooth substance by fruit juices and found that if solutions in water and in saliva were reduced to exactly the same degree of acidity, as far as could be determined by titration with various indicators, the action of the water solutions was much more marked than the action of the saliva solutions. The viscosity of the solutions may have been a factor.

Dr. Gies tells us he saws these teeth from the jaw of a cadaver, so that there shall be no cracking or abrasion by the use of a forcep. While this question does not affect the findings in the least, I want to ask whether the drying of the tooth in the cadaver may not possibly affect, in degree, the result. When we dry protein substance, its solubility is affected to a greater or less extent, and in such work as I have been able to do, I have used the extracted teeth, taking them directly from the mouth, immersing them in salt solution, sometimes with a particle of thymol, and then judging of the action of the acid by a careful weighing in water.

In regard to the discoloration of the tooth in the sets on which Dr. Gillett reported, he spoke particularly of the oxyphosphate of copper, and we were told Ames' oxyphosphate of copper was used. You know that this contains some oxide of copper, considerable oxide of zinc, oxide of cobalt, and every sample I have examined contains oxide of iron, some more than others, and I am wondering if this mixture is not responsible for color change.

In this particular set—the teeth were filled with various filling materials and then covered with a wet cloth—is it not possible that electrolytic action has been a factor, particularly in the

disintegration of the filling? When you put a gold filling and a silver-tin filling in proximity, sometimes the patient has to get used to the sensation, and electrolytic action must be present when we have an acid capable of dissociation; moreover we have learned that all chemical action is due to dissociated molecules in presence of two or more different metals.

We are under great obligation to Professor Gies for the work he has done, but let us not leave it all for him to do. I have heard expression of a feeling that while we have a man with the ability and resources of Professor Gies at work on dental problems there is little use of anyone else doing anything. And it is true in a way, we will agree, but at the same time different viewpoints are always worth while, and I feel we should be making a mistake not to keep right on with our own investigations even if made in a humble way. Original investigation is good for the individual and negative results are often valuable.

Dr. Joseph Head, of Philadelphia—I, as a very amateurish chemist, would never for a moment question the chemistry of Dr. Gies. I myself have done work in times past somewhat along the lines followed by him, and I am much impressed with the ingenious way in which he keeps the teeth in an even state of moisture, and in a state which so closely simulates the condition ordinarily found in the mouth. I am overcome with admiration as I see his technique, and it reminds me of some of my own former troubles when I see him working to keep the specimens from getting dry. If he lets them get dry, there is simply the week's work or the month's work gone.

Therefore I speak not from the chemist's side but from the dentist's side of these experiments. He has put these teeth under the observation of dentists. We dentists all look into the mouth and we see teeth that are daily being brushed with a harsh dentifrice, and year by year they look the same, until all at once we see a spot of enamel give way, the dentin shows underneath, and then we see that something has happened. With all this brushing Dr. Gies has done so honestly and finely, there is a bare possibility that a thinning of that enamel has taken place that is not shown.

In some experiments that I made with fruit acids I sometimes place a sound tooth into a fresh strawberry for five min-

utes and then take it out and look at it, and there would be a lovely frosting on the outside, and I would rub it on my coat-sleeve and you could never tell there had been any acid erosion at all there.

I even doubt if Dr. Gies put these under the microscope whether he would notice any change, unless he subjected them to a stain, and then perhaps not; but I should say that perhaps it would be wise, when the next friction experiments are made, that some detail be looked to, somewhat in the line of the work I have done. It might be wise to take perfectly sound teeth, grind them flat on one side, and with a micrometer carefully measure diameters of the ground surface, and of both enamel and cementum. The latter measurements might reveal changes impossible to be detected by mere microscopic inspection.

I sympathized with Dr. Gies when he told about his experiments. One is a perfect slave. One hardly dares to go to sleep for fear that the time will pass for the next step.

I brushed teeth, ground and measured as I have described, with the saliva mixtures of various chalks, and I found that carbonate of calcium that was slowly precipitated was much more erosive than quickly precipitated chalk. Saliva and ordinary precipitated chalk would rub off 1/10,000 of the enamel with ordinary friction of the brush in ten minutes. The ordinary tooth powders, with ten minutes' brushing, would cut the cementum from 60 to 80/10,000 and the enamel from 1/20,000 to 3/20,000 of an inch. When I looked at the teeth afterwards they were beautifully polished and you could not see anything, but I knew from measurements that that brushing had taken off that amount of tooth structure.

I think it would be wise to have these teeth prepared so they could be measured before and after the experiments. For the dentists who have undertaken this work under the genius and supervision of Dr. Gies I have nothing but the highest admiration, and I think the dental profession owes them a debt of gratitude.

Dr. Hyatt—I should like to ask Professor Gies if the teeth were placed in contact, one with another in the paraffine as in the mouth, whether there would not be secured some different results? Even with the cloth over the teeth there is a question

whether there is a fluid there in constant contact, as if the teeth were in contact with each other.

Dr. MacNaughton—Under what condition would the acid phosphate be found in the saliva? At a meeting we had here years ago, it was stated that in cases of nervous exhaustion that might be found.

Dr. Gies—Replying first to Dr. MacNaughton's question, I wish to say that acid phosphate is a ***normal*** constituent of saliva. The acid phase of the amphotericity of saliva appears to be due to it and carbon dioxid. I know of no saliva that was ever found to contain, even in pathological states, as much acid phosphate as the proportion (0.25% NaH_2PO_4) employed in our experiments (F, G).

In response to Dr. Hyatt's inquiry, let me express the belief that, if the teeth had been in lateral contact in the experiments showing the influence of the fermentation of glucose (A, B), the effects would have been more decided in a shorter time than were the results exhibited, because such contact would have favored greater stagnation of the liquids involved, therefore greater local concentration of ***fermentation*** substances, consequently more direct and vigorous action at such points. So far as the effects of water (C), carbon dioxid (E), mucin (D, G) and acid phosphate (F, G) are concerned, however, it seems probable that the continuous contact of these substances with the sides of the crowns would have induced no effects that their continuous contact with the tops of the crowns failed to elicit. The cloth covers effected by capillarity, intimate retention on the tops and sides of the crowns, of an abundance of our liquid media; and I believe the teeth were subjected to conditions fully equal, if not greater, in harmful possibilities, than those normally prevailing in the mouth, so far as the action of water, carbon dioxid, acid phosphate and mucin were concerned. We seem to have applied much larger relative quantities of the last three substances than the proportions that ever act on the teeth in equal periods of time under natural conditions. The cloth covers certainly effected close and continuous contact under capillarity conditions wholly analogous in character, though not in location, to those maintained between the teeth in the mouth. The vinegar treatment was obviously applied more effectively and generally,

under the conditions of our experiments, than it could be under those of the oral environment.

We had planned to test, after the conclusion of the experiments just described, some of these beliefs, especially with reference to the possibility of retention of vinegar between teeth closely in contact, in its use as a dentrifrice. It seemed inexpedient to go into this, however, before we learned whether such use of vinegar and food-acid media in general was devoid of harmful effects under the most favorable conditions for brushing and flushing *all* surfaces, as in the cases of the teeth exhibited tonight. These and many similar matters will be considered *experimentally* as our work is extended in scope.

I have listened with great interest to the remarks of Drs. Smith and Head, who have been all too flattering in their personal allusions.

I hope professional dental educators will consider very carefully what Professor Smith has said about the present deficiency in chemical instruction in dental schools. This criticism, especially from an eminent dental educator, must be almost as discouraging to dental pseudochemists as my recent intimation to Drs. Kirk and Bunting, that dentists proposing to conduct research in chemical dentistry should do so with the aid of chemical training and under the influence of chemical comprehension.

[In passing, I desire to call your attention to the fact that as a biological chemist I have never made any pretensions to being a dentist. A year ago the dental findings in our annual report were made by dentists—Drs. Linton and Merritt. *This* year the dental findings are announced by dentists—Drs. Gillett, Linton, Merritt and Wheeler. I myself, two years ago, proposed this collaborative procedure, *as soon as special dental knowledge was needed for the exact interpretation of our chemical and physiological results.* This passing comment is dedicated to the memory of those who have objected to my suggestion that, as dentists and chemists, we should "stick to our lasts."[1]]

Professor Smith's comment on the protective action of the

[1] Gies: *Journal of the Allied Dental Societies*, 1914, ix, p. 297; *Dental Cosmos*, 1914, lvi, p. 856.

saliva accords with my own knowledge and belief. Our supplementary report (referred to on page 554) will present new details in this connection.

Unless enamel is a chemical compound of an unsuspected character, capable of forming insoluble anhydrates, I do not believe the partial desiccation of teeth (as it occurred in our cadavers) would increase the resistance of the enamel to the action of acid media. If, however, this opinion is incorrect, it is obvious that similar changes in enamel's resistance would occur in the teeth of " mouth breathers " and under conditions of ordinary speaking and singing. Prior to the inauguration of these experiments I found that both dry and fresh teeth showed entirely similar behavior in aqueous acid solutions dilute enough to effect slight but discernable decalcification in a given period of time. So far as concerns the findings reported to-night, let me add that the sets of teeth subjected to the longest treatment (K, L) were supplied seventeen months ago by Drs. J. Morgan Howe and C. C. Linton.[2] The resistance of these teeth was evidently not due to a change of the kind that Professor Smith suspects. I had assumed, besides, that such breaks in the enamel surface as occur from desiccation (as distinguished, of course, from gross lesions due to extraction with forceps) might make the teeth from cadavers desirably *more susceptible* than fresh ones to our acid treatments. I have also assumed that by keeping the teeth wet, any susceptibility that might have been lost by desiccation was gradually and effectively restored, and loss of such restored susceptibility in turn prevented.

Professor Smith's remarks about the different metals in the disintegrated fillings in set B (under the influence of glucose-fermentation products) emphasizes the suspicions I mentioned. The possibility of electrolysis, to which Professor Smith refers, in this connection, is one of the possibilities, you recall, which led me to propose the inclusion of filled teeth in these tests. I believe there was electrolysis, as Professor Smith suggests, but I also think our results show qualitatively just what may occur in the mouth under similar conditions of fermentation, juxtaposition of fillings, etc. The buccal, labial and lingual surfaces doubt-

[2] Lothrop and Gies: *Journal of the Allied Dental Societies*, 1913, viii, p. 304.

less *facilitate* similar continuity of liquid connection between teeth and fillings, and also favor to some extent the degree of stagnation in the fermenting oral fluid which would be favorable to the free development of electrolytic disintegration.

Professor Smith concluded his remarks with a criticism that is more of a compliment than I could possibly deserve. The larger the number of workers on any problem, the greater the chances of achieving a solution. No man, however earnest, or however able, or however aided and guided, can possibly accomplish more than a small fraction of the work of his day in any field. Remember always that there can be no such thing as an "authority" in dentistry or in chemistry, and that the humblest and least appreciated worker may be, or may *make* himself, *better qualified* for the discovery of truth than any man who ever preceded him. But let me emphasize the important consideration that good intentions, ardent enthusiasm and professional ambition cannot be a substitute for real *qualifications in the work of effective research* in any branch of the arts and sciences—"*qualifications*" which usually involve careful preliminary training, besides natural aptitude, and the capacity for hard work, sustained endeavor and concentrated application.

The suspected thinning of the enamel, to which Dr. Head refers, is a possibility on which I have no direct information. But we have found that teeth may be immersed in dilute vinegar (1:1) for two successive five-minute periods without the loss therefrom of a detectable trace of calcium.[3] Under such circumstances it seems to me that the enamel would not appreciably soften and be brushed away during such dentrifricial applications as were made in our experiments—applications which would doubtless never be effected so thoroughly, vigorously and universally in the mouth of any person. This idea appeals to me with particular force because of my conviction that saliva exerts a "protective" action of some kind, and that it not only may induce rehardening of enamel after acid treatment, as Dr. Head himself appears to have found in the very fine experiments of his to which we alluded in our report a year ago,[4] but also aids

[3] Lothrop and Gies: *Journal of the Allied Dental Societies*, 1913, viii, p. 300.

[4] Lothrop and Gies: *Journal of the Allied Dental Societies*, 1913, viii, p. 307.

in *maintaining* in the enamel a normal degree of hardness and resistance.

I have stated to Dr. Head himself, and frequently to some of his colleagues, that I desire very much to extend and repeat his experiments with apparatus of the kind described by him[5] two years ago, and to which we referred in our report last year.[6] His experiments with that apparatus have appealed to me as experiments of great significance and value. It is a pleasure to look forward to such work with him in the future, for which we have already planned in a provisional way.

In conclusion, let me remind you of the remarks with which our report concludes. The experiments described to-night are a *second,* and a much longer, step forward in this particular field. We couldn't test everything at once in these experiments. We didn't attempt the impossible. We " had to begin somewhere " and confine our attention to a few items that could be studied directly and without confusion. As we extend this work, we shall endeavor to ascertain the determining influence of such additional conditions as immediate contact between teeth, occlusal friction, desiccation of the enamel, etc.

I think we are now amply justified in *urging* practical attention to the proposed use of food-acid media as dentifrices. I believe such treatment may be tried without serious risk, *while* its efficacy as a means of " keeping the teeth clean " is *clinically* established or effectively denied.

To those who ask " *which* food-acid medium is best adapted for such a purpose," and " in what *strength,*" I am obliged to say that I have given attention thus far in this connection to general principles only, and wish to learn more about the details of possible effects with various food-acid media before making any suggestions on these particular points. Meanwhile, however, vinegar, lemon juice, grape juice, etc.—all of them, more or less *diluted* with water, salt solution, etc., containing a good *preservative* such as alcohol, and, if preferred, one or more chemically-neutral *flavoring substances,* such as the familiar " oils," to suit the taste of the individual—are among the *many* obvious " indi-

[5] Head: *Journal of the American Medical Association,* 1912. lix, p. 2118.
[6] Lothrop and Gies: *Loc. cit.,* p. 308.

cations" for trial as prophylactic combinations. I am now using on my own teeth, with very great satisfaction, vinegar diluted with an equal volume of water. I believe this solution is stronger than necessary to effect the desired cleansing of the teeth with two daily applications—morning after arising and at night before retiring. I am adhering to its use, however, in an *experimental* way, in spite of that belief.

I regret that the discussion to-night failed to develop reports of trials of this general proposal, *especially reports adverse to the dentifricial use of food-acid media.* Perhaps in this instance "no news is good news."

I hope that a fairly large number of dentists will report findings next year on the cleansing effects of food-acid media and on the influence, if any, of such media, upon pyorrhea.

Adjournment.

FREDERICK C. KEMPLE, D.D.S.,
Editor, First District Dental Society.

THE BOSTON AND TUFTS DENTAL ALUMNI ASSOCIATION

The first meeting for the season, 1914-1915, of the Boston and Tufts Dental Alumni Association was held at Hotel Lenox, Boston, on the evening of Wednesday, October 14.

The subject, "Ductless Glands," as the topic of the evening, was to have been introduced by Dr. H. H. Germain, but as he was suddenly called away, his place was ably taken by Dr. I. H. Coriat, who was to have opened the discussion. The paper was commented upon by Dr. M. C. Smith, of Lynn. The subject proved to be of engrossing interest, and a hearty vote of thanks was extended the speakers by the members. Remarks were also made by Dr. Caines and Dr. H. A. Baker. Many beautiful specimens of X-ray work were exhibited by the various speakers, and other photographs helped in no small degree to make clear the subject under discussion. The next meeting of the association will be held in connection with the various other dental societies of the city. This union meeting is coming to be looked upon as a regular annual affair, and should prove to be a source of inspiration to all who attend.

The business meeting held prior to the dinner was called to order by the president, Dr. J. L. Taylor. Various committee reports were read, and the treasurer reported the financial condition to be very good. A vote of thanks was extended the treasurer, Dr. Geo. H. Payne, for his highly efficient efforts to put the society upon a firm financial basis.

A. G. Richburg, D.M.D., *Editor.*

THE JOURNAL OF THE ALLIED DENTAL SOCIETIES

WILLIAM B. DUNNING, D.D.S., *Editor*
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EDITORIAL DEPARTMENT

"GENERAL PRACTICE" AND SPECIALISM

In the palmy days of the ancients, the philosopher who was worth his salt knew everything. A knowledge of the arts and of literatures then existing could be grasped by a single mind; and as for physical laws—a child could comprehend that the earth was a pancake, with a domed sky above, and that the whole was "run" by competent gods and demons. Further inquiries

were unnecessary, perhaps risky, considering the rather testy disposition of the average heathen deity.

As late as the middle of the eighteenth century a "learned man" might hope to grasp the main bulk of human knowledge; but since the dawn of the nineteenth century such achievement has become, with each decade, a greater impossibility.

Of the many great sciences, medicine itself has become too vast a field for the single practitioner. We have the specialist for each region of the body—and the dental specialist now is finding his horizon stretching beyond his individual knowledge and skill. The oral cavity is a world in itself, in which the oral surgeon, the orthodontist, the prophylactic expert, the radiographer, the porcelain and gold inlay expert, the bacteriologist, the pyorrhea specialist, the prosthodontist are necessary, in co-operative practice, to meet the demands of modern dental science. The good old days of the "general practice" man have passed—at least out of the popular estimation.

It is not difficult to demonstrate that the orthodontist, who spends the year in the exclusive contemplation of his special problems, is a more skilled practitioner therein than the operator who cares for a few such cases incidentally with other work. The same demonstration is simple in regard to the other "departments" of dentistry above enumerated. And, as the growing tree must put forth new branches, which divide and subdivide, so any science must have this

history of growth, with the consequent narrowing of specialties, and the necessary narrowing of the individual viewpoint of the operator. He who would be the greatest expert must therefore be the man of straitest vision—an ultimate twig, so to speak, on the great tree. From his very nature he will have the least capacity for breadth of wisdom. He must lack forever that precious sense of perspective possessed by the man who. though competent in many ways, is expert in none.

It is undeniable that the specialist is necessary in a growing science. He it is who advances the boundaries of knowledge. But it does not follow invariably that the aggregated wisdom of specialists will net the greatest benefit for the patient in a given case.

In the large cities the specialists thrive in such degree of co-operation as to enable the patient to secure the best composite opinion; but it is to be feared that in the co-ordinating of many minds there must always be discrepancies—from temperament, policy, or what not—which spell inefficiency more or less, according to circumstances. The single hand is needed to assemble the timepiece.

Our patients often become bewildered and discouraged at being passed from hand to hand—each expert keen for ideal conditions from his point of view. When it is possible for these busy men actually to meet in consultation, they may or may not hit upon a wise general course, making for the best in a bad situation. Undoubtedly the patient suffers in many cases, from

the inability of these zealous, well-intentioned, one sided men to agree.

It is granted that the complexity of our work to-day is so great that the man who attempts all does nothing really well. Yet there is need of the mind which can "see 'round" nearly all the problems which present in daily practice—and to treat them as they present, either personally or by personal direction. There should be the mental reservation that the specialist will be called in when his skill is needed. The general practitioner should not, for instance, spend years fruitlessly upon a difficult orthodontia case which the specialist could have disposed of promptly. At the same time he should be competent to treat those numerous slight malocclusions that require little more than timely guidance.

It seems not unreasonable to hope that more men in the future will aspire to be "general practitioners" —not in the one-time sense of easy-going incompetence, but as perpetual students who choose to accept the whole responsibility of cases, within the limits of personal skill; who are always ready to consult, and, in need, to refer the patient for special treatment—who, while realizing their limitations, insist upon the general control of cases confided to their care.

CORRESPONDENCE

[The following self-explanatory letter is welcomed, because it clears up a misunderstanding in regard to which the readers of THE JOURNAL are entitled to information.

In a recent conference of Dr. Kirk and the Editor, at the latter's office, the galley proof in question and the correspondence bearing upon the same at the time of publication of Dr. Kirk's paper, were carefully examined and discussed].

THE DENTAL COSMOS,

PHILADELPHIA, October 31, 1914.

Office of the Editor.

DR. WM. B. DUNNING,
Editor, The Journal of the Allied Dental Societies,
New York, N. Y.

MY DEAR DR. DUNNING:

On receiving the June, 1914, issue of The Journal of the Allied Dental Societies I was both surprised and annoyed to find inserted in the text of my paper on the Reaction of the Saliva the following paragraph: "$Na_3PO_4 + HCl = HNa_2PO_4 + NaCl$. Although HNa_2PO_4 is in itself alkaline in reaction, does not change the chemical fact that it is as much an acid as HCl, differing from it only in strength" and to find that it had furnished justifiable grounds for the reopening of the discussion of the subject in the same issue by Dr. Gies after the discussion had been for the time being formally closed by me in accordance with the vote of the First District Dental Society, giving me that privilege.

Moreover, the incident furnished Dr. Gies with equally justifiable grounds for criticism of what, upon its face, appears to be an effort upon my part to take an unfair advantage of him in the scientific debate of the general question which was the subject of discussion in my paper.

In explanation of the foregoing I wish to say that I am quite sure that neither Dr. Gies nor the readers of The Journal could be more surprised than I was myself at the insertion of the paragraph above quoted. Its insertion was entirely accidental and the result of a clerical oversight. As you will remember, duplicate galley proofs of the paper were sent to me for final revision, in both of which I personally made certain typographical corrections and then handed one to Mr. Crowell for his consideration and for the correction of any errors in the chemical formulæ which he might discover. Mr. Crowell returned his copy of the proof to me with a marginal annotation consisting of the paragraph above quoted. This paragraph was intended by Mr. Crowell merely for my personal information and as representing his view of a point in dispute. I dictated my letter to you, transmitting the corrected proof, signed it,

and left it with instructions to enclose and mail the galleys which I had myself corrected. By an unfortunate mistake, Mr. Crowell's galleys, with his marginal annotation, were sent instead of the revision which I had prepared, and the marginal annotation which he had made was unfortunately, and without my knowledge or any intent on my part, included in the published article.

I wish to place the foregoing facts on record in order to eliminate, as far as possible, any question which the accident may have aroused in the minds of the readers of The Journal regarding the appearance of unfairness on my part which the inserted comment of Mr. Crowell may have raised. I am already assured by Dr. Gies personally that the accident which has led to this unfortunate circumstance is fully understood by him. Finally, I wish to say, with regard to the whole question at issue, that it seems to me that the differences of opinion between Dr. Gies and myself as brought out by our discussion of the important fundamental question of the reaction of the saliva, are really differences in point of view rather than essential differences of fact. I am altogether in sympathetic harmony with the expressed motive of Dr. Gies, which leads him to search out the truth on this question, and I am grateful to him for all that he has done in that direction. My real difference with him is with reference to what I may characterize as his technique in debating his topic with the man with whom he disagrees in opinion.

Very truly yours,
(Signed) Edward C. Kirk.

NOTES ON PRACTICE

COMPILED BY WILLIAM D. TRACY, D.D.S.

Suggestions on Cavity Preparation.—Some operators seem to think that it is necessary to give the cavity a cone shape, so that the inlay wax will draw, and the finished inlay will go properly to its place. Such is not the case. As long as there is no undercut the wax will draw, and the best form that we can possibly give to our inlay preparation is the one that approaches the box form—that is, a cavity with flat seats and parallel walls. If the cavity is so made and the buccal and lingual axial marginal line from the occlusal to the gingival surface is a straight one, and parallel with the one on the opposite side of the tooth—that is, if the buccal and lingual axial lines are parallel—then, if the margin at the occlusal surface is in clean territory, the angles at the gingival surface will also be in safe territory; but the prevalent form is the one that allows the lines to converge gingivally, and the consequence is unsafe bucco- and linguo-gingival angles.—J. V. CONZETT, *The Dental Cosmos.*

Removing Plaster from a Vulcanite Denture.—Now and again a thin coat of plaster on the palatal surface or between the teeth of a vulcanite denture proves difficult of removal, especially if the case is not promptly removed from the flask after vulcanizing. The denture is placed for a few minutes in a cold mixture of about equal parts of sulfuric acid and water, or the "pickle pot"; no injury is done to the denture, while the plaster is softened or dissolves, so that a little work with a brush wheel leaves it clean.—W. H. TRUEMAN, *Dental Brief.*

Round Envelopes for Dental X-Ray Films.—A black envelope such as is used for the inner envelope in X-Ray plate work is cut into small sections of any desired size, using the edge of the envelope, where the fold forms one side of the smaller envelope. The corners are trimmed round, and the two pieces of film, with the emulsion sides toward each other, are cut to fit the round envelope. This envelope is then sealed with black passepartout paper, and inclosed in oiled tissue paper. A small tab of white paper may be placed on the envelope on the edge covered by the passepartout paper, to identify easily that part of the envelope when in the dark room. The envelope is easily slit up with a knife at this point, the films removed, and the new ones inserted. The envelope is again covered with passepartout paper. Films may be made from the ordinary film roll, film pack, or moving picture films. Those which lie flat are better, as they do not curl while being cut nor during development. These envelopes require very little time to prepare. They are more comfortable to hold in the mouth, can be made of any size to suit the needs of the case, and by their use a larger area of teeth and maxilla can be shown than on the ordinary rectangular film.—R. HAMMOND, *Dental Brief.*

Finishing Amalgam Fillings.—Nothing could be more hideous than a coronal cavity in a lower molar filled with a formless plug of amalgam. The carving of the filling is most interesting, and is easily carried out. What is more, I am inclined to believe that this carving, by dividing the surface into little hills and valleys, may possibly control the shrinkage of the amalgam should it occur. We all know that in placing a porcelain body upon its platinum base, we score it into squares, so that contraction may take place about each square as a center. In the same way it is not unlikely that any marked surface contraction, should such a thing occur, might, by carving cusps and fissures upon it, be converted into a series of little contractions, thus minimizing the fault to a certain extent. At a subsequent sitting, the filling must be polished with finishing burs, then with pumice or orange-wood sticks in the porte-polisher. A word of caution is necessary in rĕgard to the first dressing of this filling with the bur. Amalgam is more or less brittle, and it is quite easy to crush it at the margins of the cavity by too rough handling. In this particular it resembles—only to a less degree—synthetic cement, which we all know may be ruined as a filling by the careless use of coarse disks and strips.—J. M. Lewis, *Australian Journal of Dentistry.*

Four Factors Aiding Retention in Porcelain.—The four points as aids in retention which it is well for the porcelain worker to keep in mind are: (a) Correction of the occlusion; (b) sterilization of the dentin; (c) shaping of the cavity, and (d) manipulation of the cement.—J. J. Moffitt, *The Dental Cosmos.*

Crowns Upon Molars with Very Divergent Roots.—Krischensky, in a communication which originally appeared in the *Bulletin de l'Amicale des Elèves et Anciens Elèves de l'Ecole Dentaire Française, October, 1913*, suggests the following method for pivot crowns on upper first bicuspids and molars with very divergent roots:

Upper first bicuspids are prepared by grinding the tooth down to the cervical margin. The two canals are then enlarged with a reamer, and their apices filled. In the lingual canal, a post is inserted of such length that it will protrude 2½ mm. above the gingival surface and a block of wax is built up around it of 3 cubic mm. diameter. The buccal surface of this wax cube is rounded so as to leave a buccal margin of about 1½ mm.; post and wax block are removed together, invested, and cast in gold. The post and block are then cemented on the tooth and oiled, and the rest of the tooth is built up in wax, after a post has been fitted in the buccal canal, removed, invested, and cast in gold. If a Richmond crown is to be inserted, the gold block on the root is oiled, the facing fitted, the lingual and coronal portion built up in wax, withdrawn with the pivot in the buccal canal, invested, cast, and cemented to the tooth, thus insuring great stability and resistance. In three-rooted molars, the palatal root is treated in the manner described for first bicuspids, the post and cast gold block are cemented to the palatal root, the posts for the buccal roots are fitted parallel to one another and to the cast gold

block, which is oiled. The crown is then built up in casting wax, withdrawn with the buccal root pivots, invested, and cast in gold.—*Le Laboratoire et le Progrès Dentaire, The Dental Cosmos.*

Preventing the Buckling of Gold Plates.—To prevent the buckling of gold plates in swaging, a slit is cut at the median line, from the margin to the ridge, lapped over, and when swaged, soldered. This should be done in all cases, as this is the weakest point and the plate breaks there. By doing this, the weak point is doubled in strength.—L. P. Haskell, *Dental Review.*

Prevention of Thumb-sucking.—The tiniest infant is never too young to be taught, if a tendency to thumb-sucking is seen. If the infant is but a few weeks old, and thumb-sucking is begun, the sleeves of the little dress should be pinned to the coverlet, which is not a great hardship, as at this age the infant cannot move much. Later on, when this method must be discontinued, and if the habit it still persisted in, the hand should be constantly closed in little linen bags tied securely to the wrists.—C. E. Kells, *Oral Hygiene.*

Insertion of Gutta Percha.—Having made the cavity as dry as possible I apply a little Oil of Cajuput on a pellet of cotton. Then a fair-sized piece of gutta percha is warmed, dipped in cajuput, and pressed home with a conical warm instrument. Each additional piece is moistened with cajuput, the last piece is placed dry, and the filling is finished off with an instrument that has been dipped in cocoa butter. This imparts a fairly dense surface to the filling.—G. C. Nicholson, *The Dental Cosmos.*

Preservation of the Color of Devitalized Teeth.—The prevalent practice of wiping out the bloody canal with a solution of hydrogen dioxid cannot be too strongly condemned. Hydrogen dioxid simply decomposes the blood within the tooth and oxidizes the iron of the hemoglobin, and the gases evolved force the pigment into the tubuli, where, if left—and it is difficult to remove—it will cause the tooth to darken in almost every instance.—L. J. Brown, *The Dental Cosmos.*

Easy Method of Repairing Defects in Gold Crowns and Bridge Work.—Mercury and filling gold are mixed in the same way as amalgam. The mixture is packed over the hole in the crown or in the defect in the bridge work to be repaired. With soldering pliers the crown is held high over the gas flame so as to heat very slowly. As the mass reaches 350 C. the mercury volatilizes, leaving the pure gold covering the hole or filling the defect. This gold is burnished to a smooth surface, and the operation is complete.—C. O. Dobson, *Dental Summary.*

Pressure Anesthesia in Multi-rooted Teeth.—Operations are many times delayed owing to the necessity of waiting for pulp devitalization, because difficulty is experienced in the employment of pressure anesthesia in multi-rooted teeth. The cause of this difficulty lies in the fact that the cocain solution is forced into the pulp tissue of the larger canal instead of into that of the smaller—that is, it follows the line of the least resistance, making the removal of the pulp from the small canals very painful.

To avoid this, an exposure of the pulp is made, a small pellet of cotton previously saturated with the anesthetic solution is placed over the exposed pulp, and pressure is produced. I prefer wax; base plate wax in summer, bite wax in winter, to vulcanite rubber, especially in cavities involving the proximal surface. Generally, by one application the pulp in the chamber and in the largest canal will be anesthetized. If the initial exposure is small, one application may be required to allow painless excavation for a larger opening. The pulp is removed from the large canal, a wisp of cotton inserted, a ball of wax slightly larger in diameter than the mouth of the canal is rolled, and packed firmly into it. The first procedure is then repeated in order to anesthetize the pulp tissues in the smaller canals, the pulp is removed, and then a barbed broach is pressed through the wax in the large canal, and given a half turn to engage the cotton. On removal of the wax stopping, the canals are ready to be dried and filled.—W. N. MILLER, *The Dental Cosmos.*

Removing a Shell Crown Without Mutilating.—A small hole is drilled buccally just below the occlusal surface of the shell crown, and an old instrument with a slightly curved point is inserted into the hole. By using the surface of the root as a fulcrum, it is surprisingly easy to remove the crown from the root. The hole in the shell crown can easily be repaired.—H. R. S. TAYLOR, *The Dental Cosmos.*

Treatment of Hypertrophied Gingivae.—The following remedy can be highly recommended for combating hypertrophy of the gingivae so common in pregnant women: Zinc chlorid, 2 parts; peppermint water, 250 parts.—*Annales de la Soc. Dental de Habana, The Dental Cosmos.*

Seventy Per Cent. Alcohol Best for Disinfection.—According to the investigations of Beyer, as published in the Muenchener Med. Wochenschrift, 1912, p. 1408, the maximum disinfectant power of alcohol is at 70 per cent., while absolute alcohol is a weaker disinfectant.—*Deutsche Monatsschr. f. Zahnheilkunde, The Dental Cosmos.*

CURRENT DENTAL LITERATURE

COMPILED BY C. WILLIAM RUBSAM, D.D.S.

FOCAL INFECTION: ITS BROAD APPLICATION IN THE ETIOLOGY OF GENERAL DISEASE. By Frank Billings, M.D., Chicago, Ill.—*Journal A.M.A., September, 1914.*

Circumscribed and confined infection, commonly expressed as focal infection, has long been recognized as an important etiologic factor in systemic disease. Yet as a principle, it has not received sufficient attention from practitioners. In the author's opinion, focal infection is very frequently related to local and general disease.

The focus of infection may be located anywhere in the body. Furthermore, secondary foci in lymph-nodes proximal to the primary focus and to systemically infected joints, muscles, etc., become additional sources of continued and more general infection. "Overdentistried" teeth may cause or prolong alveolar disease. Secondary local infectious foci may serve as adjuvants to further prolong and intensify systemic disease. A study of the tissues and exudates of the focus usually yields various bacteria. With the defenses of the body diminished by overwork, exposure to cold, dissipation, insufficient or improper food, unhygienic surroundings, injuries from former disease (valvular scar), or trauma, the individual may suffer from acute rheumatic fever, chronic arthritis, myositis, chronic infectious endocarditis, pneumonia, ulcer of the stomach, cholecystitis, or pancreatitis, respectively dependent on the phase of mutation in pathogenicity, and affinity of the strain of the streptococcus-pneumococcus group in the focus of infection. These principles are important because proper management may (a) prevent the systemic disease, and (b) guide one in the proper treatment of the systemic disease. The recognition and removal of chronic foci anywhere in the body is imperative as a prevention of progressive ill-health. Emphasis should be made of chronic alveolar abscess, often unrecognized by the patient. Film roentgenograms of the jaws are often the only means of recognition. A pathologic tonsil is a menace and should be wholly removed. Following the removal of the focal infection, adequate individual and general hygiene will improve the body defenses and health will be maintained. The attempt to immunize the patient against the infection must be attempted by restorative measures—food, pure air, passive and active graduated exercises, hematinic and other tonics, optimistic surroundings, etc. Autogenous vaccines may be used with rational reservation.

SUPPORTING LOOSE TEETH. By Dr. Prothero.—*Dental Register, September, 1914.*

In cases where the peridental membrane is weakened, where with extraordinary or ordinary stress these teeth can be moved, then if they are connected by inlays soldered together, there is going to be a good deal more service rendered that patient from a masticatory standpoint

than if those teeth were restored and the inlays not attached. A case has been in the mouth for three or four years, and the patient is getting good service from the teeth in that manner, and Dr. Prothero is satisfied that the teeth would have been lost long ago had they not been connected in some such manner. The point that is immediately brought out in objection to the connection of the inlays by soldering is this, that the free movement of the roots of the teeth is restricted and more or less irritation will follow, and possibly result in the loss of the teeth. Now, it is those cases where the peridental membrane is weak where this condition is necessary, and we find when a case has been treated in this manner and the inlays have been in place for two, three, or four years, they are much firmer than when the inlays were first set in place.

ACCURATE OCCLUSAL SURFACES IN PORCELAIN CROWNS. By Dr. A. L. Le Gro.—*Dental Register, August, 1914.*

Coping that can be removed from articulated models is built up with modeling compound just short of occluding space for cusps and marginal ridges. This is left flat on top, oiled and warm modeling compound placed on the same, and occlusal articulation made by triturating in anatomical articulator. From this a button of the modeling compound is carved containing all fine grooves, sulci, indication of buccal and proximal contour and marginal ridges. The button is placed in small amount of plaster for female die from which a male die is again made in modeling compound of more generous diameter than original button, to facilitate handling, etc. From this die a matrix is stamped (plat. 1-1000) reproducing all the fine carvings of the original button. A button of porcelain is baked in this cup of platinum, and the platinum is then stripped of the buccal and proximal periphery as high as possible without stripping the matrix from the fine carvings in the occlusal surface. The button is then put in its position on the articulator, and the crown is baked between the coping as a matrix on the one side and the matrix of the occlusal surface of the porcelain on the other, producing a posterior porcelain jacket or Richmond crown as perfect in detail as one is able to carve in any material, no attention having been given to shrinkage of porcelain or any of the inconveniences attending the usual carved porcelain crown.

FATALITIES FROM SALVARSAN. *Clinical Medicine-Dental Register, September, 1914.*

The eight deaths following the intradural administration of neo-salvarsan-serum for nerve syphilis in one hospital in Los Angeles, all occurring within forty-eight hours, have brought home to the medical profession more strikingly than ever before the fact that salvarsan is not alone a useful drug, but a dangerous one as well. At least 275 deaths are known to have followed its administration, while in all probability the total number is several times this, since nearly every physician can tell of cases which have not been reported. In a recent book upon the subject, Wechselmann brings out the important point that very many of

these deaths from salvarsan may be attributed to the combined or alternated use of salvarsan and mercury. He declares that anything delaying the excretion of an arsenical preparation brings out the toxic action of that drug and may cause a fatal issue. For this reason he strongly advises against administering salvarsan following the giving of mercury, and especially of metallic mercury, inasmuch as the latter drug interferes with normal kidney function and thereby delays excretion. Clinical medicine finds the moral of this observation to be, that before using salvarsan a careful chemical and microscopical examination of the urine should be made in every instance. Also, salvarsan and mercury in large dosage should never be employed together. And, finally, when the combined treatment seems to be indicated, the arsenical preparation always should be given first, and never, under any circumstances, after a course of treatment with a mercurial. They say there is no denying the value of salvarsan, and they have no disposition to minimize the importance of Ehrlich's great discovery. Yet time has only served to teach the thoughtful caution in the use of this remedy, the injudicious administration of which they now know to be fraught with dangers little dreamed of by the average physician. Mercury still stands first as a specific remedy for syphilis. Not only is it safe, but its curative value is undoubtedly greater than that of salvarsan. The latter drug has its own place; but, for the present, it may well be left to men who are thoroughly familiar with its field and know best how to use it.

The Specific Cause and the Prompt Specific Cure of Pyorrhea Alveolaris or Rigg's Disease. By C. C. Bass, M.D., and F. M. Johns, M.D., Tulane College of Medicine, New Orleans.—*New Orleans Medical and Surgical Journal, November, 1914.*

The writers of this article state that they have established the fact that amebæ are found invariably in pyorrheal conditions. Eighty-six out of eighty-seven cases examined showed the presence of amebæ. In normal mouths they could not be found. Their presence is ascertained by microscopic examination of a smear taken from the deeper regions of a pyorrheal lesion. The characteristic amæboid motion distinguishes them readily. They vary in size from about that of a luecocyte to about three or four times this size. The stained specimens show them perfectly. Ipecac and its active principle, emetin, have been used to cure amebic dysentery by hypodermic use. The writers have introduced the use of emetin, hypodermatically, and state that it has made the amebæ in the mouth disappear after one to three daily doses of ½ to 1 grain, each. The duration of the absence of the amebæ has not been definitely determined. The danger of reinfection is great, but if the emetin inhibits the ameba while nature is repairing the dental tissues subsequent to thorough instrumentation, its use will prove very valuable in rational pyorrheal treatment. This next year promises to bear valuable fruit along this line, if the investigations of the authors of this article are continued with the thoroughness with which they have been begun.

CURRENT NEWS

Items of professional news, of general interest, will be welcomed by the Associate Editor at 51 West Forty-seventh Street, New York City.

The American Ambulance Hospital in Paris is one of which all true Americans should be proud, and it is worthy of all the support that the combined efforts of those in the United States can enlist for it.

Quoting from a letter written by Mr. Francis E. Drake, Vice-President of the American Chamber of Commerce in Paris to Dr. S. E. Davenport, President of the First District Dental Society of New York State, the following is of interest:

"You may already know that this hospital, which has been organized entirely by Americans, and which is being conducted by eminent American surgeons and supported by the contributions of Americans, has been pronounced by the military and professional authorities abroad to be the highest type of military hospital. . . . More than anything else, the Ambulance Hospital has resulted in gaining an international appreciation of American science and skill in surgery and medicine.

"One department of the hospital is of particular interest to your profession. For the first time in the history of military hospital work, I believe, a completely equipped dental department has been installed, and the splendid work done by it has been of such inestimable value that it is probable that this American example will hereafter be followed by all military hospitals.

"In charge of the dental department are Dr. Wm. S. Davenport and Dr. Hayes, of Paris, and associated with them are other American dentists prominent in their profession in Paris, all of whom have generously volunteered their services.

"The importance of the work of the American Ambulance Hospital cannot well be exaggerated. *The wounded of every creed, color or nationality are welcome,* so that this humanitarian work is consistent with the strictest neutrality. . . .

"All this work is done by volunteers, and the money for incidental expenses is donated. Contributions should be sent to J. P. Morgan & Co., who are cabling the money received daily to Paris. . . . We estimate that a fund of $500,000 will be needed. Of this amount, we have raised about $120,000 among Americans in Paris and about $95,000 here, so that about $300,000 is still necessary. I am telling you our financial needs, but what we most earnestly desire from the members of your profession is endorsement and moral support."

In a letter written October 22, 1914, Mr. Robert L. Bacon says: "I believe that this is the first time that the importance of dental work in the care of the wounded soldiers has been so universally recognized. It is the only military hospital in Europe to-day that has a dental department, and it has won the widest praise from the medical profession of both England and France."

From the official circular of the American Ambulance Hospital we learn that it "has been taxed to its utmost; that every available bed now in the hospital—about 400—is in use"; that there is room for and there should be 1,000 beds.

An eye-witness says: "Every patient admitted to the Lycee Pasteur has his mouth examined. It will surprise nobody who has any knowledge of conditions in the field to learn that in the vast majority of cases the teeth are found to require cleansing and attention. They are, even in the best cases, in such a state that they are ready to act as poison distributors. In the bad cases they are apt to have a detrimental influence upon the strength and recuperative power and to make recovery a slow process."

All this shows the importance of dental surgeons from a military standpoint, and one cannot help but wish that funds enough could be raised to provide for 1,000 beds in this hospital instead of only 400, as at present. It is interesting to us to know that both Dr. W. S. Davenport and Dr. Hayes are members of the First District Society.

At the suggestion of its President, Dr. S. E. Davenport, and with the approval of the Board of Directors, this Society has decided to dispense with its annual dinner this year—we can all dine any time—and to contribute part of the usual cost per cover to this American Ambulance Hospital.

There will be an extra meeting on December 19, a Ladies' Night, instead of the dinner, and there will be good speaking and refreshments to further cheer those present. In this way quite a sum of money should be raised, and every dentist in the vicinity of New York City should feel it his particular duty to attend this special meeting and contribute to its success by financial and moral support. If a man is unable to be on hand it would not be out of place to pay for his "dinner," anyway.

Here in America it is impossible for us to realize the terrible conditions that must exist abroad, and since this is, in a sense, our own hospital, doing a wonderful work—our work—let us support it!

* * *

The 1914-15 programme for the meetings of the Harriet N. Lowell Society for Dental Research has been announced, and is as follows:

October 8. Open meeting. Addresses by Dean E. H. Smith and Dr. H. F. Libby.

December 10, Dr. T. Ordway.

February 11, Dr. Harvey Cushing.

April 8, Dr. A. W. Doubleday.

May 13, Dr. F. A. Delabarre.

Many men are not familiar with the fact that the Harvard Dental School has a Society of its own, the object of which is to encourage real research work by the students. Such, however, is the case.

Miss Harriet N. Lowell was a patient of Dr. Lyman S. Bigelow, of

Boston, Mass.; a graduate of Harvard, and he was so successful in interesting her in dental needs that when she died it was found that she had made a bequest of $50,000 for research work—$25,000 to the Harvard Medical School and $25,000 to the Dental School.

The interest from this fund is available every year for dental research work under the administration of a committee, consisting of the following men: Prof. H. Carleton Smith, Dr. Leroy M. S. Miner, Dr. L. W. Baker, Dr. George Wright and Dr. W. H. Potter. It is not really expected that students will accomplish wonders while still in college, but that the undergraduates, being educated in an environment of research work, will produce men who later on will develop into star performers in this important phase of dentistry. The laboratory of the Society is equipped with apparatus for chemical, microscopical and bacteriological investigations.

The presence of this Dental Research Society at Harvard is only one of many factors which combine to make that school one of the real leaders in dental education.

* * *

The New York *Evening Mail* on November 6 published the following account of a method of anesthesia which was brought forward in a paper read by Dr. R. Kendric Smith, Director of the Department of Public Health in the American Osteopathic Association:

"The reflex pressure anesthesia is administered by grasping the second joint of a finger or toe between the thumb and finger and holding it firmly, close to the distal end, for about one minute. For another minute press similarly on the dorsal and plantar aspects.

"The patient promptly says that the finger feels numb, and he traces the progress of the wave of numbness extending gradually upward the entire height of the body. When the numbness passes the location of the pain for which the anesthesia is being administered, the suffering ceases, and when the area to be operated upon in dentistry or minor surgery is reached by the numb wave, surgery may be instituted without pain.

"The thumb will anesthetize the two incisors on its own side, the forefinger the first bicuspid, the second finger the next two, the third finger the next and the little finger the last. The thumb and fingers are used for dental work, but for minor surgery or for a larger area, pressure is exerted on the radius and ulna at the wrist."

This sounds easy!

BOOK REVIEWS

By C. Franklin MacDonald, D.M.D.

Local Anesthesia in Dentistry. With Special Reference to the Mucous and Conductive Methods. A Guide for Dentists, Surgeons and Students. By Professor Dr. Guido Fischer, Director of the Royal Dental Institute of the University of Marburg. Translated by Dr. Richard H. Riethmüller, of the Dental Department of the Medico-Chirurgical College, Philadelphia. Large octavo, 244 pages, with 115 engravings (mostly colored) and 2 plates. Cloth, $4.00, *net*. Publishers: Lea & Febiger, Philadelphia and New York, 1914.

But two short years have elapsed since the first edition of this great work upon local anesthesia in dentistry appeared. The value and necessity of this volume was at once apparent, and this second edition is certainly needed to fill the growing demand for an authoritative text book upon this subject. Throughout the country dentists are beginning to appreciate the value of local anesthesia and the possibilities of its application. It is rapidly replacing the use of general anesthetics in the great majority of cases, and its use as an efficient means of abtunding sensitive dentin is being realized more and more.

The contents and arrangement of subject matter in Dr. Fischer's book are essentially the same as in the previous edition.

In the first section is to be noted the use of Ringer's solution as a vehicle for the novocain suprarenin instead of the normal salt solution, with its admixture of a trace of thymol. The author has revised his opinion as to the possible danger of tablets being a source of infection, and now advocates their use. Under instrumentarium, several additions are seen in the introduction of the indio-platinum needle, trocar needles, flasks to keep Ringer's solution in, graduated porcelain cups, etc., all of which are aids in this line of work.

Parts II and III, the indications for local anesthesia and the technique of local anesthesia, are of the same lucid and definite character as in the older edition. Very little, perhaps, could be added to the most complete original. Peridental and intra-osseous injections are considered in a short chapter as the author states, "merely for the sake of completeness; for practise they offer no advantage whatever, and are complicated and dangerous." A number of new plates of anatomical specimens are to be noted which add further to the clearness of the text.

Little can be added to the original criticism of this work, except to reiterate its value and to say that this edition has progressed with the growing subject. It is the best treatise on the application of local anesthesia for dentistry which the profession now has, and all students and practitioners should be familiar with its contents.

[Original review this Journal, June, 1912.]

Local Anesthesia: Its Scientific Basis and Practical Use. By Professor Dr. Heinrich Braun, Obermedizinalrat and Director of the Kgl. Hospital at Zwickau, Germany. Translated and edited by Percy Shields, M.D., A.C.S., Cincinnati, Ohio, from the third revised German edition. Octavo, 399 pages, with 215 illustrations in black and colors. Cloth, $4.25, *net*. Publishers: Lea & Febiger, Philadelphia and New York, 1914.

The discovery of suprarenin and the introduction of novocain as a local anesthetic agent has resulted in considerable enthusiasm for this method of anesthesia.

For the dental profession Dr. Fischer has, without question, revolutionized the attitude and application of local anesthesia to the surgery of the mouth, while Professor Braun has been called "the father of local anesthesia" for general surgery. It is a happy coincidence that this mention of Braun's book should appear in conjunction with the new edition of Fischer's book, because it is upon Braun's earnest and careful work that Fischer has depended, and it is Braun who is most often quoted as *the* authority.

This volume, by Braun, is written primarily for the medical man—for the general surgeon; and takes up all possible phases of local anesthesia.

The author commences at the beginning and takes the reader through the past history of local anesthesia as practised in ancient times and also of modern times by means of drugs, cold, compression, etc. The various drugs advocated have been thoroughly and scientifically investigated as to their good and bad qualities with their particular places for use. The inquiry is finally summed up by presenting novocain and alypin as the two most suited for all local anesthesia, except tropacain and stovain, which still continue to be used for lumbar anesthesia. The use of suprarenin with the drugs for anesthesia is fully considered, and the great value of this addition to the injected solution is emphasized.

Under the various methods of using anesthetic solutions he presents the method of infiltration, conduction, vein and artery. The latter two methods being applicable only under special conditions and when the usual anesthetic methods are not possible. The aid of electrical cataphoresis is considered to be of little value.

The technique of infiltration and conduction anesthesia is considered at first in a general way with the instrumentarium. The particular technique is elaborated upon as each field of operation is considered.

The latter half of the book is devoted to an exposition of the actual application of local anesthesia to the various operative fields which ranges literally from the top of the head to the removal of a toe. For practically all possible surgical procedures, the author presents a technique for local anesthesia. Some of the cases are admittedly not particularly suited to this form of anesthesia, although a practical possibility. The author finds it necessary at certain stages in some cases to employ a light general anesthetic for a short period of time.

The operations upon the head and neck perhaps offer the best field

for local anesthesia. The extensive operations performed under local anesthesia will perhaps be a revelation to the average reader, as for instance, the resection of the upper jaw with removal of contents of orbit, of which Professor Braun shows a photograph taken during the process of the operation. Methods for injection of foramen rotundum, ovale and the Gasserian ganglion are carefully considered, and should prove valuable to those interested in the alcohol treatment for tic doloreux.

Extraction of teeth and operations upon the alveolar processes receives a short chapter which is quite limited in detail. Injection is advocated "between the mucous membrane and the periosteum," instead of beneath the periosteum, as recommended by Fischer.

Operations upon the thorax and abdomen are considered with the most recent and successful technique. In this field the operation for hernia seems to offer the greatest chance of success, and it seems doubtful whether adherents will be found for some of the others, owing to the difficulties of technique and uncertainty of anesthetic results. The author considers that the psychological effects of these operations with the patient fully conscious is not of great consequence, but this may still be a grave question in the minds of many surgeons.

Genito urinary, rectal and operations upon the extremities completes the volume.

Local anesthesia is becoming more and more popular, as the technique is being improved and the possibilities of its application has greatly enlarged. Its greatest advantages at present seem to be the lack of danger to life since the advent of novocain and the bloodless field of operation due to the action of suprarenin.

To the general surgeon this work should prove to be most entertaining and valuable, and offer material assistance in many fields of operative procedure where general anesthesia has been deemed indispensable. For the dentist, and particularly for one interested in the surgical aspect of his profession, the book will be most interesting, demonstrating as it does the great scope and possibilities of modern local anesthesia.

A MANUAL OF DENTAL PROSTHETICS. By George H. Wilson, D.D.S., formerly Professor and Demonstrator of Prosthetics and Metallurgy in the Dental Department of Western Reserve University, Cleveland, Ohio. Second edition enlarged and thoroughly revised. 12mo, 531 pages, with 386 illustrations. Cloth, $4.00, *net*. Publishers: Lea & Febiger, Philadelphia and New York, 1914.

At the time of the publication of the first edition of Dr. Wilson's book it was noticed, particularly, that the volume was well adapted for the student's use, being compact and direct and of moderate price. The second edition follows the same principle of conciseness as the original.

A few additions have been made relative to research work which the author has been conducting concerning the properties of expansion and contraction of plaster of Paris, and an investigation into the vulcanization of rubber for dental appliances. Of these, the latter experi-

ments are perhaps the most interesting and important. As to practical vulcanization the author concludes that a Spence compound cast be used, a flask kept closed by a spring instead of bolts, use of pink rubber in the interior of thick dentures and vulcanization in steam at 320 degrees F. for one hour and twenty minutes.

For those concerned with cleft palate work the addition of Dr. V. E. Mitchell's most excellent paper will prove very interesting.

To the chapter on Esthetics has been added a short paragraph upon the lips as to their importance in the dental profile and the importance of their proper contour. The author says—and correctly it seems—"a dentist who is satisfied with the mounting of artificial teeth by a commercial dental laboratory shows himself deficient in the esthetic sense, and owes it to himself and his patient to either develop the esthetics of prosthesis or eschew prosthetic dentistry." The first portion of this chapter might well be utilized as the opening paragraph to the volume to convey to the student's mind the fact that prosthesis is not a mere trade, but an artistic accomplishment necessitating great patience and labor and worthy of being dignified as a profession in the full meaning of that word.

The author has certainly condensed to the minimum—almost to the danger point—the theoretical aspects of anatomical articulation. Practical application is, of course, the main objective, but a certain amount of theory is necessary, even though a bore.

This volume seems to be most suitable as a reliable text book for the student in connection with lectures, but can also fill a place as a handy book in the library of the practitioner.

[Original review this JOURNAL, September, 1912.]

DENTAL RADIOLOGY. By Francis Le Roy Satterlee, Jr., A.M., D.Sc. Price, $3.00. Publishers: Swenarton Stationery Company, New York City, 1914.

This short volume of 200 pages, including blank pages for notes, is, according to the author, "written primarily as a text book for the undergraduate dental student." It has been approved and adopted as a text book by the American Institute of Dental Teachers.

The contents are devoted to the practical exposition of dental X-ray work, the theoretical aspects being but lightly touched upon. Following the idea of a laboratory manual, each chapter is followed by a few blank pages for additional notes derived from a lecturer or other sources.

The introduction is rather unhappy, somewhat from inelegant phraseology, but chiefly from the unfortunate aspect of commercialism which it tends to convey, and as this book is intended primarily for the dental students in our college, this attitude is to be deplored.

For one who wishes a simple and easily understood essay upon the practical dental uses of the X-ray, this small volume should prove very acceptable. In conjunction with lectures and clinical demonstrations as a laboratory manual, it should serve an excellent purpose, but hardly seems elaborate enough to be classed strictly as a text book.

OBITUARY

Ferdinand J. S. Gorgas.

Ferdinand J. S. Gorgas, A.B., A.M., D.D.S., M.D.—an honorary fellow of the American Academy of Dental Science, died in Baltimore, Md., April 8, 1914, in the eightieth year of his life.

In his profession he was known and honored as one of the most notable men of his time, both as author and educator. He received the degree of A.B. and A.M. from Dickerson College, and his dental degree in 1854 from Baltimore Dental College where he taught as Dean and Professor from 1867 until 1882. He received his medical degree from the University of Maryland in 1863, and was Dean and Professor there from 1882 until 1911, where he held the chairs of Prosthetic Dentistry, Oral Surgery, and Dental Medicine. He was editor of the *American Journal of Dental Surgery*, of Harris's "Principles and Practice of Dentistry," and of Harris's Dental Dictionary. He was also author of a work on "Dental Medicine" and of "Questions and Answers for Dental Students." He was a member of the Maryland State Dental Association, and an honorary fellow of many societies. His burial was at Greenmount Cemetery, Baltimore. Professor Gorgas was an enthusiastic teacher, ever eager to raise the ethical and educational standard of his profession. A widow and two sons survive him. These sons are Dr. L. D. Gorgas, of Chicago, Ill., and Dr. H. F. Gorgas, of Baltimore, Md.

Resolved, That in the death of Professor Gorgas the Academy has lost one of its most valued fellows. His colleagues, recognizing his great educational power, gave to him the many important positions which he held with such marked ability in the institutions he so faithfully served.

Respectfully submitted,
Robert R. Andrews,
Forrest G. Eddy,
Edward C. Briggs,

Committee.

SIDNEY S. STOWELL.

Killed, May 10, 1914, by trolley car accident, Sidney S. Stowell, D.D.S., of 67 Howard Street, Pittsfield, Mass.

Dr. Stowell was born in Peru, Mass., in 1858; received his early education in district schools; worked as student in the office of Dr. Charles L. Anderson, Springfield, Mass.; graduated from the University of Pennsylvania in the 80's; and, after a short association with Dr. J. Searle Hurlbut, Springfield, opened a practice in Pittsfield, where he continued until his death.

He was a member of the Connecticut Valley Dental Society. In 1887 he demonstrated the "Stowell Tooth Crown" at the Ninth International Medical Congress in Washington. In 1896 he was on the staff of the New York Dental School, and in 1897 served as thirty-third president of the Massachusetts Dental Society. Since that date Dr. Stowell has been an active member of the First District Dental Society and the New York Academy of Medicine, and an honorary member of the New York State and the New Hampshire Dental Societies.

Dr. Stowell's chief interest, outside of his profession, lay in aeronautics, and he was a member of the Pittsfield Aero Club.

In 1910 he married Blanche E. Hulse, by whom he is survived.

With deep regret THE JOURNAL announces the passing of two eminent practitioners who, for half a century, were leaders in the advancement of dental science. Dr. J. Morgan Howe, of New York, died on November 13th; Dr. James Truman, of Philadelphia, on November 26th. Extended notices of the life and work of Doctor Howe and of Doctor Truman will appear in our next issue.

NOTICES

THE PANAMA-PACIFIC DENTAL CONGRESS

The Committee of Organization of the Panama-Pacific Dental Congress wishes it distinctly understood that the Panama-Pacific International Exposition will not be postponed, but will open on time, as will also the Panama-Pacific Dental Congress. The authority for this statement is impressed in the following letter from President Moore of the Exposition Company:

TO THE COMMISSIONERS FROM FOREIGN NATIONS AND FROM THE STATES AND TERRITORIES OF THE UNITED STATES TO THE PANAMA-PACIFIC INTERNATIONAL EXPOSITION.

Gentlemen.—There have been reports that the Exposition, because of the war in Europe, would be postponed. It will not be postponed.

There have been published statements that the war in Europe would seriously affect the commercial or educational importance or the financial success of the Exposition. They will not be so affected.

The Exposition will open on its scheduled date—February 20, 1915. It will be completely ready when opened. It is more than ninety per cent. completed to-day. Nothing will be permitted to interfere with the consummation of the plans originally laid down.

Many friends and parties in interest have presented arguments in support of postponement for a year. These have been given anxious study and careful analysis. Most of them are merely counsels of timidity, based on nothing save a general feeling of doubt and uncertainty. These are sufficiently answered by saying that there is no longer any doubt or uncertainty as to the success of the Exposition whatever the situation in Europe may be. Other arguments for postponement have some practical foundation, but for every one of these there is a stronger and better argument for proceeding with our plans.

The Exposition will, therefore, open as scheduled. There is not the slightest reason to believe its success, in any phase, will be any less than that which was so certain before the European war broke out. Not one of the nations at war has notified of an intention to withdraw her participation; France and Italy have, in fact, notified us that their plans remain unchanged, but even if we should lose the others the interest and importance of the Exposition would still, as a whole, surpass all precedent.

As to the Domestic participation, the effect of the European war seems likely to be rather advantageous than otherwise. The stimulus on exhibits is already felt, as American manufacturers become impressed with the opportunity given by the Exposition for bringing their goods to the attention of the large distributors of Central-South America, the Orient and Canada.

As to attendance, all expert opinion agrees that there is nothing in the situation, even if continued through 1915, that will effect seriously the willingness or ability of the people of the Western Hemisphere and of the Far East to visit the Exposition. Some opinion is firm that travel to California may even be increased by the war. The decision of the Exposition management has, however, been reached without regard to that consideration. We consider it our duty alike to our nation, to the participating nations, to our exhibitors and to ourselves to carry out the plans as originally laid down and which, now nearly at fruition, promise the most important, the most beautiful and the most successful Exposition in history.

(Signed) CHAS. C. MOORE, President.

At the present time matters relating to the Panama-Pacific Dental Congress are most encouraging. The attendance so far as can be judged by those who attended the meeting of the National Dental Association in Rochester, and the meeting of the New Jersey State Dental Society will break all previous records. Every one said he was coming, and the Committee of Organization wishes to assure all prospective members that they will be well cared for in every way.

Papers and clinics by some of the most noted members of the dental profession have already been contributed to the program. A large portion of the available exhibit space has been taken by manufacturers and dealers, and the success of this part of the Congress is positively assured.

The new Municipal Auditorium in which the Congress will be held is being rapidly completed, and will afford facilities for this Congress such as no other similar meeting has enjoyed. It is centrally located and may be reached by numerous street car lines from the Exposition grounds, or any hotel in San Francisco, in from five to twenty minutes.

The San Francisco Hotel Bureau, with offices in the Flannery Building, San Francisco, will look after the reservations for hotel accommodations for our guests. We earnestly advise all those who intend to attend the Congress to make their reservations early. Many congresses will be held in San Francisco during the months of August and September, 1915, and many will be in session at the time of the meeting of the Panama-Pacific Dental Congress, and for obvious reasons the reservation of rooms should not be delayed.

Following is a circular letter from the San Francisco Hotel Bureau:

San Francisco Hotel Reservations for 1915.—You can get all the rooms you want in San Francisco in 1915, and at reasonable rates.

By official tabulation there are 1,328 hotels and rooming-houses, which, with 600 apartment-houses, represents a total of over 90,000 rooms, with accommodations for over 200,000 guests at any one time. In process

of construction there are over 150 hotels and apartment-houses that will be completed before the Exposition opens, giving nearly 15,000 rooms more, and in addition there are thousands of flats and rooms obtainable in private residences. Fully 98 per cent. of these hotels and apartment-houses have been built within the last six years, so that all are modern and up-to-date.

With the purpose of making it as easy as possible for prospective visitors to secure any accommodations desired and at guaranteed rates, the San Francisco Hotel Association, representing more than 350 hotels, rooming and apartment-houses, has incorporated the San Francisco Hotel Bureau with a capital of $100,000. This Bureau will make contracts for hotel and other accommodations in any number required during the Exposition year, and it guarantees all its contracts. A San Francisco Bank is its depository. These accommodations will be contracted at rates of from $1 to $3 a day, per person, European plan, and from $3.50 and up a person, per day, American plan, for any date and for any length of time desired. No fees or charges of any kind will be required, but a satisfactory guarantee must be given that the rooms will be used at the time stated in the contract.

The Bureau has the endorsement of and is operated in conjunction with the Panama-Pacific International Exposition; the San Francisco Convention League; the San Francisco Hotel Association, and other civic bodies.

Applications for reservations should be directed to Kirk Harris, manager of the San Francisco Hotel Bureau, Kearny and Market Streets, San Francisco.

Make your reservations now.

BROOKLYN, N. Y., October 22, 1914.

To the Editor, Journal Allied Dental Societies:

Dear Sir.—The enclosed resolutions were adopted by the Second District Dental Society at a meeting held October 12, 1914.

Will you kindly publish same in your magazine?

Yours sincerely,

THADDEUS P. HYATT,
Chairman Executive Committee.

RESOLUTIONS.

Whereas, The members of the Second District Dental Society of the State of New York have learned with deep concern of the distress and hardships which have been brought to our confreres because of the European War; therefore, be it

Resolved, That this Society expresses its deepest sympathy to all

members of the Dental Profession affected by the war, regardless of nationality; and, be it further

Resolved, That this Society will gladly co-operate in any movement which will in any way alleviate the distress or difficulties of any of those whom we look upon solely as brother workers in a common cause; and, be it further

Resolved, That copies of these resolutions be sent to the dental magazines and the Associated Press, with the request that they be published.

HARVARD DENTAL ALUMNI ASSOCIATION

A special meeting of the Harvard Dental Alumni Association will be held at the Harvard Union, corner of Harvard and Quincy Streets, Cambridge, Mass., on Thursday, January 14, at six o'clock. Dinner will be served at seven o'clock; tickets, $1.50 each.

Every one of the graduates of the School is cordially invited to attend, whether or not he is a member of the Association. After dinner we will hear something about Harvard athletics, and we have the promise of the use of the reel of moving pictures of the last Yale game.

HAROLD DEW. CROSS, President.
FRANK T. TAYLOR, Secretary.

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[Abbreviations: abs., abstract; disc., discussion; rev., review; edt., editorial; ed., edition.]

Date Due

LIBRARY RULES

HOURS 11-12 A.M.

1. One book only will be issued on presentation of borrower's card.

2. Books may be retained for a period of four days. Renewal for four days more will be made upon request.

3. A fine of 5 cents per day will be charged on books not returned when due.

4. Borrowers will be charged for all injury to books.

LIBRARIAN'S HOURS

MONDAY AND FRIDAY, 9-12 A.M.
WEDNESDAY, 1-4 P.M.